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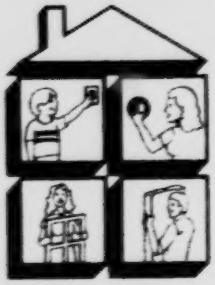

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Newfoundland & Labrador Home Energy Advisory Pilot Project

APPENDIX TO FINAL REPORT

SHAWMONT NEWFOUNDLAND LTD.

CONSULTING & MANAGEMENT SERVICES

APPENDIX I

PEI ORIENTATION SESSION TRAINING SCHEDULE

WEEKEND AUGUST 14 & 15
OPEN ALL DAY
Sunday, August 15

Time	Staff	MONDAY AUGUST 16
8:30	BK DE	Status Review
9:00	BK DE	Training Program .Setting up a Training Program . .Training Approaches .Scope and Sequence
11:15	KM BK	Trainee Selection Process
12:00		Lunch Break
1:15	REA VMG	Lead Field Audit
		EVENING OPEN

Time	Staff	TUESDAY AUGUST 17
8:30	RB RA AM	Heating Systems Analysis
10:15	RB	Heat Loss Calculations
12:00		Lunch Break
1:15	REA VMG	Field Audit Visiting Management Groups Take Audit Lead
7:30	AM DE BK RB	Informal Discussion Private Sector Involvement in Audit Programs

Time	Staff	WEDNESDAY AUGUST 18
8:30	DE OH REA VMG	Audit Debriefing Review of Field Audits of August 16 and 17
12:00		Lunch Break
1:15	REA VMG	Field Audit
		EVENING OPEN

Time	Staff	THURSDAY AUGUST 19
9:00		WORKSHOPS:
	DE	I - Communications - Support Materials Development
	BK	II - Training - Rationale Elaborations - Performance Assessment
	RB	III - Technical Infiltration Factors
10:30	BK	Review Training Program Elaboration
12:00		Lunch Break
1:00	RB	Field Audit
2:30	ADS VMG	ADS Staff and Visiting Management Groups
		Dinner

Time	Staff	FRIDAY AUGUST 20
8:30	ADS STAFF	EVALUATION SESSION:
	DE AM	Management Component
	BK	Training Component
	DE	Communications Component
	RB	Technical Component
11:00		Linkage Session Future Communication and Activities for On-going Consultation
12:00		Lunch Break
2:15		ADS Staff Available to Respond to Individual Needs or Requests
3:30		Preparations to Return

PROPOSED SCHEDULE: PILOT ENERGY AUDIT PROGRAMS - ORIENTATION

Time	Staff	MONDAY AUGUST 9	Time	Staff	TUESDAY AUGUST 10	Time	Staff	WEDNESDAY AUGUST 11	Time	Staff	THURSDAY AUGUST 12	Time	Staff	FRIDAY AUGUST 13	Time	Staff
8:30	VHG	Introductions All Around	8:30	DB BK AW	Review of U.S.R.C.S Programs	8:30	RB	(Optional)Technical Overview of Audit Procedure	8:30	REA VHG DE	.Audit Debriefing .Review of Field Audits August 9, 10 and 11	9:00		WORKSHOPS:		
9:00	BK	Review of Workshop Activities August 9 to August 20	9:30	RA	.Presentation of Millbank Procedure (sound/slide) .Discussion of Millbank Origin	10:15	DE	Communications: Component Conceptua Development	12:00		Lunch Break		RB BA	I - Flowcharting the Audit Program		
10:00	LH	Field Audit Scheduling Procedures	10:30	DE	.Departures from Millbank .Evolution of ENERPLAN .Refinement of EHR Methodology	11:00	BK	Training Program Conceptual Development	1:15		Observe Field Audit		BK PG	II - Training Program Curriculum & Instruction		
10:30	DE	.Discussion of PEI Workplan .Background of the Project	11:00	DB	Millbank to ENERPLA Development of Form	12:00		Lunch Break	7:30	ADS VHG	Optional General Discussion Technical - Management - Training - Communications		DE AW	III - Management Controls and Organization		
11:00	DE VHG EHR	.Pilot Program Integration .Discussion of The Four Pilot Proposals - Gaps & Overlaps	12:00		Lunch Break	1:15	REA VHG	Observe Field Audit				10:30	RA PG LH	Equipment: Lab - Training, and Field Requirements		
12:00		Lunch Break	1:15	REA VHG	Field Audit	7:30	ML	Economic Evaluation Techniques for Energy Conservation Analysis						AFTERNOON OPEN Gold Cup and Saucer Day		
1:15	REA VHG	Observe Field Audit	7:30	REA VHG BK	Empty House Audit Data Collection Forms									EVENING OPEN		
7:30	AW RA DE EHR	Program Policy and Objectives														

APPENDIX II

BACKGROUND ANALYSIS FROM HOUSEHOLD REPORT

EXHIBIT 1

HOUSING STOCK BY TYPE, NFLD
(000's)

Year	Total Households	DWELLING TYPE					
		Single Detached	%	Single Attached	%	Apartment or Flat	%
1951	71	59	83.1	7	9.9	4	5.6
1961	88	75	85.2	9	10.2	4	4.5
1971	110	88	80.0	12	10.9	10	9.1
1981	149	121	81.2	11	7.4	17	11.4

Source: Statistics Canada

EXHIBIT 2

HOUSEHOLDS SHOWING THE PERIOD OF CONSTRUCTION OF THE DWELLING, N.F.L.D., 1975 - 1981

(000's)

YEAR	TOTAL HOUSEHOLDS	PERIOD OF CONSTRUCTION					
		BEFORE 1940	%	1940-1959	%	1960 & AFTER	%
1975	125	34	27.2	39	31.2	53	42.4
1976	130	28	21.5	40	30.8	63	48.5
1977	135	26	19.3	39	28.9	70	51.9
1978	137	29	21.2	40	29.2	67	48.9
1979	140	31	22.1	41	29.3	68	48.6
1980	144	31	21.5	36	25.0	77	53.5
1981	149	28	18.8	39	26.2	82	55.0

SOURCE: Statistics Canada (#64-202)

EXHIBIT 3

ROOMS PER DWELLING, NEWFOUNDLAND
(000's)

YEAR	TOTAL DWELLINGS	NUMBER OF ROOMS PER DWELLING																
		1	2		3		4		5		6		7		8		9+	
			#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%
1953	79	--	4	5.1	5	6.3	11	13.9	17	21.5	21	26.6	10	12.7	6	7.6	--	
1961	88	--	--		6	6.8	9	10.2	24	27.3	21	23.9	14	15.9	7	8.0	5	5.7
1971	110	--	--		5	4.5	13	11.8	31	28.2	30	27.3	18	16.4	7	6.4	5	4.5
1981	149	--	--		6	4.0	14	9.4	33	22.1	43	28.9	26	17.4	16	10.7	10	6.7

SOURCE: Statistics Canada

EXHIBIT 4

PRINCIPAL HEATING EQUIPMENT, NEWFOUNDLAND
ALL DWELLINGS
(000's)

YEAR	TOTAL HOUSEHOLDS	FURNACES						HEATING STOVES	%	ELECTRI-CITY	%	COOK STOVES	%	OTHER	%
		STEAM OR HOT WATER	%	HOT AIR											
				FORCED	%	OTHER	%								
1951	75	--	--	--	--	--	--	16	21.3	--	--	54	72.0	--	--
1961	88	4	4.5	7	8.0	5	5.7	19	21.6	--	--	53	60.2	--	--
1971	110	18	16.4	30	27.3	8	7.3	24	21.8	--	--	28	25.5	--	--
1981	149	21	14.1	40	26.8	--	--	18	12.1	51	34.2	13	8.7	--	--

SOURCE: Statistics Canada (#64-202)

EXHIBIT 5

PRINCIPAL HEATING FUEL, NEWFOUNDLAND
(000's)

YEAR	TOTAL HOUSEHOLDS	OIL OR OTHER LIQUID FUEL	%	PIPED GAS	%	BOTTLED GAS	%	ELECTRI-CITY	%	COAL OR COKE	%	WOOD	%	OTHER	%
1951	75	--	--	--	--	--	--	--	--	27	36.0	38	50.7	--	--
1961	88	31	35.2	--	--	--	--	--	--	24	27.3	33	37.5	--	--
1971	110	94	85.5	--	--	--	--	--	--	--	--	10	9.1	--	--
1981	149	78	52.3	--	--	--	--	52	34.9	--	--	18	12.1	--	--

SOURCE: Statistics Canada (#64-202)

EXHIBIT 6

HOUSING STOCK BY AGE, ST. JOHN'S CMA AND NFLD

Period of Construction	CMA		Newfoundland	
	No.	%[1]	No.	%[2]
Pre-1946	10,710	25.9	38,240	26.8
1946-1960	9,545	23.1	40,110	28.1
1960-1971	9,380	22.7	31,095	21.8
1971-1980	11,765	28.4	39,555	26.5

[1] Annual Summary of Planning Data and Activities - City of St. John's Planning Department (1981).

[2] Canada Housing Heating Performance and Improvability - Scanada Consultants Ltd. (1979).

EXHIBIT 7

DWELLINGS BY STRUCTURAL TYPE, 1981

Characteristics	NFLD	%	St. John's CMA	%
Occupied Private Dwellings	148,420		43,295	
Owned	119,695	80.6	30,100	69.5
Rented	28,725	19.4	13,210	30.5
Single Detached	116,495	78.5	27,385	63.3
Single Attached	14,660	9.9	7,890	18.2
Apartment 5+ storeys	870	.59	600	1.4
Apartment 5 storeys	7,705	5.2	4,425	10.2
Duplex	3,825	2.6	2,235	5.2

Source: Statistics Canada (E-559).

EXHIBIT 8

INSULATION LEVELS AND OCCURRENCE

Years		Wall Insulation		Attic Insulation	
		Uninsulated	Insulated	Uninsulated	Insulated
Pre-war	%	75	25	50	50
	RSI	.76	1.76	.55	2.11
1945-50	%	30	70	20	80
	RSI	.76	1.76	.55	2.11
1950-60	%	30	70	20	80
	RSI	.76	1.76	.55	2.11
1960-75	%		100		100
	RSI		1.76		2.11
Post-75	%		100		100
	RSI		2.11		2.29

Source: Canada Housing Heating Performance and Improvability, Scanada Consultants.

OCCURRENCE OF BASEMENT INSULATION

Years	Uninsulated	Half Insulated	Insulated
Pre-1945	94	2	4
1945-61	82	5	13
1962	50	10	40

EXHIBIT 9

HOUSING STOCK BY TYPE *

	SINGLE DETACHED (n=875) %	OTHER (n=148) %
TOTAL SAMPLE (n=1023)	85.5	14.5
One Storey (n=629)	92.4	7.6
Two Storey (n=251)	69.7	30.3
Other (n=143)	83.2	16.8

* Chi-square statistic significant at the 0.05 level

EXHIBIT 10

PERCENTAGE OF HOUSING STOCK IN SAMPLE BY AGE BAND

	BEFORE 1945 %	1945-1960 %	1961-1970 %	AFTER 1970 %
TOTAL SAMPLE (n=1017)	18.2	22.5	22.5	36.8
One Storey (n=621)	8.7	20.6	28.8	41.9
Two Storey (n=253)	41.9	30.0	8.7	19.4
Other (n=143)	17.5	17.5	19.6	45.5

PERCENTAGE OF THE VARIOUS HOUSING TYPES IN THE SAMPLE BY AGE BAND

	BEFORE 1945 %	1945-1960 %	1961-1970 %	AFTER 1970 %
TOTAL SAMPLE (n=1004)	17.9	22.2	22.7	37.2
Single Detached (n=865)	17.3	23.6	22.8	36.3
Other (n=139)	21.6	13.7	22.3	42.4

EXHIBIT 11

NUMBER OF ROOMS PER DWELLING UNIT

NUMBER OF ROOMS	DWELLINGS	PERCENTAGE
4 or less	107	10.6
5	225	22.2
6	311	30.7
7	182	18.0
8	94	9.3
9 or more	94	9.3

EXHIBIT 12

NUMBER OF ROOMS BY HOUSING TYPE **

	SINGLE DETACHED %	OTHER %
TOTAL SAMPLE (n=1013)	85.4	14.6
4 or less (n=107)	78.5	21.5
5 rooms (n=225)	80.9	19.1
6 rooms (n=311)	84.6	15.4
7 rooms (n=182)	89.0	11.0
8 rooms (n=94)	92.6	7.4
9 or more (n=94)	92.6	7.4

** Chi-square statistic significant at the 0.01 level

EXHIBIT 13

HOUSING TYPE BY SQUARE FEET OF LIVING SPACE

	TOTAL SAMPLE (n=922)	less than 900 (n=302)	900-1200 (n=388)	1201-1500 (n=125)	more than 1500 (N=107)
SINGLE DETACHED %		31.3	43.7	13.7	11.3
OTHER %		42.5	31.2	12.7	13.6

Note: This table was calculated by IBI Group from the Square Feet of Living Space by Housing Type table found in Appendix B.

EXHIBIT 14

HOW MANY ROOMS IN THE HEATED AREA OF YOUR HOME ARE NOT FULLY HEATED?

(n=362)

	PERCENTAGE
None	14.4
One	10.2
Two	20.7
Three	35.6
Four or More	19.1

EXHIBIT 15

PRINCIPLE HEATING SOURCE
BY PERCENTAGE OF THE SAMPLE
(n=1018)

	PERCENTAGE
Electric - Electric Baseboard	29.5
- Electric Furnace (Hot Water)	1.2
- Electric Furnace (Warm Air)	1.2
Oil Furnace (Hot Water)	12.9
Oil Furnace (Warm Air)	18.1
Oil Stove	3.6
Wood Stove	18.3
Wood Furnace	6.4
Combinations of Above	8.8

EXHIBIT 16

INCOME

(n=1002)

	SURVEY PERCENTAGE	NEWFOUNDLAND POPULATION* PERCENTAGE
Less than $7,000	11.9	11.8
$7,000-$10,999	16.7	17.1
$11,000-$13,999	9.9	11.3
$14,000-$16,999	9.7	10.2
$17,000-19,999	9.0	9.5
$20,000-$29,999	26.2	25.1
$30,000-$34,999	6.0	6.7
#35,000 and over	10.4	8.4
	100.0	100.0

* Statistics Canada 1979 Information

EXHIBIT 17

HOUSING TYPE BY INCOME LEVEL

	LESS THAN $14,000 %	$14,000 - $25,999 %	$26,000 AND OVER %
TOTAL SAMPLE (n=986)	38.5	36.9	24.5
Single Detached (n=838)	39.3	35.4	25.3
Other (n=148)	34.5	45.3	20.3

INCOME LEVEL BY HOUSING TYPE

	SINGLE DETACHED %	OTHER &
TOTAL SAMPLE (n=986)	85.0	15.0
Less than $14,000 (n=380)	86.6	13.4
$14,000-$25,999 (n=364)	81.6	18.4
$26,000 and over (n =242)	87.6	12.4

EXHIBIT 18

EXISTENCE AND EXTENT OF RENOVATION BY INCOME LEVEL

	LESS THAN $14,000 %	$14,000 - $25,999 %	$26,000 AND OVER %
TOTAL SAMPLE (n=224)	34.8	43.3	21.9
$1,000 or less (n=65)	43.1	36.9	20.0
$1,000 - $2,500 (n=69)	39.1	42.0	18.8
$2,500 and More (n=90)	25.6	48.9	25.6

INCOME LEVEL BY EXISTENCE AND EXTENT OF RENOVATION

	$1,000 OR LESS %	$1,000 - $2,500 %	$2,500 OR MORE %
TOTAL SAMPLE (n=224)	29.0	30.8	40.2
less than $14,000 (n=65)	35.9	24.7	26.5
$14,000-$25,999 (n=69)	34.6	29.9	26.5
$26,000 and Over (n=90)	29.5	45.4	46.9

EXHIBIT 19

WHO CARRIED OUT RENOVATION BY INCOME LEVEL

	LESS THAN $14,000 %	$14,000 - $25,999 %	$26,000 AND OVER %
TOTAL SAMPLE (n=226)	34.5	42.9	22.6
Myself-Family (n=135)	36.3	45.9	17.8
Family-Friends (n=52)	38.5	34.6	26.9
Other (n=39)	23.1	43.6	33.3

EXHIBIT 20.1

FOR EACH ENERGY CONSERVATION MEASURE, INDICATE WHETHER IT HAS ALREADY BEEN DONE, CONSIDERED, OR NOT UNDERSTOOD

SUMMARY

	ALREADY DONE	WOULD CONSIDER	NOT UNDERSTOOD
Turn Off Lights & Appliances Not in Use	96.4	3.6	0
Avoid Freezer Ice Buildup	75.2	21.3	3.5
Ensure Freezer Full to Operate Efficiently	46.8	35.8	17.4
Close off Portions of Home Not in Use	45.1	42.1	12.8
Use Cool Temps. in Wash Cycle	70.5	26.9	2.6
Install Hot Water Flow Restrictors	12.6	63.6	23.7
Set Back Thermostat at Nite	90.2	7.9	1.9
Have Furnace Tuned & Upgraded	61.3	30.8	7.9
Add Insulation to Attic	84.7	14.7	.6
Add Insulation to Walls	74.9	24.4	.6
Add Insulation to Basement	68.0	31.1	.9
Add Weatherstrip to Doors	78.9	20.5	.6
Add Weatherstrip to Windows	74.3	24.9	.8
Add Weatherstrip to Attic Hatch	57.4	41.0	1.6
Add Caulking in Cracks	64.3	32.5	3.1
Install Storm Windows	71.0	27.7	1.2
Install Domestic Solar Hot Water System	3.9	45.4	50.8
Install Wood Stove	56.6	40.1	3.3
Reduce Temp. Setting on Hot Water Tank	53.9	40.1	5.9
Dry Clothes Outdoors	91.7	7.9	.4

This table was derived from frequencies on the social survey questionnaire in Appendix V.

EXHIBIT 20.2

FOR EACH ENERGY CONSERVATION MEASURE, INDICATE WHETHER IT HAS ALREADY BEEN DONE, CONSIDERED, OR NOT UNDERSTOOD

BY INCOME LEVEL

TURN OFF LIGHTS AND APPLIANCES NOT IN USE

	LESS THAN $14,000 %	$14,000 - $25,999 %	$26,000 AND OVER %
TOTAL SAMPLE (n= 996)	38.9	36.4	24.7
Already Done (n= 959)	38.3	36.6	25.1
Would Consider (n= 37)	54.1	32.4	13.5
Not Understood (n= 0)	-	-	-

EXHIBIT 20.3

FOR EACH ENERGY CONSERVATION MEASURE, INDICATE WHETHER IT HAS ALREADY BEEN DONE, CONSIDERED, OR NOT UNDERSTOOD

BY INCOME LEVEL

AVOID FREEZER ICE BUILDUP

	LESS THAN $14,000 %	$14,000 - $25,999 %	$26,000 AND OVER %
TOTAL SAMPLE (n=982)	38.7	36.8	24.5
Already Done (n=740)	39.3	37.4	23.2
Would Consider (n=209)	36.8	34.9	28.2
Not Understood (n=33)	36.4	33.3	30.3

EXHIBIT 20.4

FOR EACH ENERGY CONSERVATION MEASURE, INDICATE WHETHER IT HAS ALREADY BEEN DONE, CONSIDERED, OR NOT UNDERSTOOD

BY INCOME LEVEL

ENSURE FREEZER FULL TO OPERATE EFFICIENTLY

	LESS THAN $14,000 %	$14,000 - $25,999 %	$26,000 AND OVER %
TOTAL SAMPLE (n=947)	38.5	37.3	24.2
Already Done (n=446)	38.3	37.7	24.0
Would Consider (n=338)	38.5	37.3	24.3
Not Understood (n=163)	39.3	36.2	24.5

EXHIBIT 20.5

FOR EACH ENERGY CONSERVATION MEASURE, INDICATE WHETHER IT HAS ALREADY BEEN DONE, CONSIDERED, OR NOT UNDERSTOOD

BY INCOME LEVEL

CLOSE OFF PORTIONS OF HOME NOT IN USE

	LESS THAN $14,000 %	$14,000 - $25,999 %	$26,000 AND OVER %
TOTAL SAMPLE (n= 906)	39.6	36.3	24.1
Already Done (n= 405)	42.2	33.3	24.4
Would Consider (n= 387)	38.0	37.5	24.5
Not Understood (n= 114)	36.0	43.0	21.1

EXHIBIT 20.6

FOR EACH ENERGY CONSERVATION MEASURE, INDICATE WHETHER IT HAS ALREADY BEEN DONE, CONSIDERED, OR NOT UNDERSTOOD

BY INCOME LEVEL

USE COOL TEMPERATURES IN WASH CYCLE**

	LESS THAN $14,000 %	$14,000 - $25,999 %	$26,000 AND OVER %
TOTAL SAMPLE (n= 967)	38.8	36.4	24.8
Already Done (n= 679)	35.6	37.7	26.7
Would Consider (n= 263)	44.5	34.2	21.3
Not Understood (n= 25)	64.0	24.0	12.0

** Chi-square statistic significant at the 0.01 level

EXHIBIT 20.7

FOR EACH ENERGY CONSERVATION MEASURE, INDICATE WHETHER IT HAS ALREADY BEEN DONE, CONSIDERED, OR NOT UNDERSTOOD

BY INCOME LEVEL

INSTALL HOT WATER FLOW RESTRICTORS

	LESS THAN $14,000 %	$14,000 - $25,999 %	$26,000 AND OVER %
TOTAL SAMPLE (n=912)	38.0	37.2	24.8
Already Done (n=112)	41.1	36.6	22.3
Would Consider (n=586)	34.8	38.7	26.5
Not Understood (n=214)	45.3	33.2	21.5

EXHIBIT 20.8

FOR EACH ENERGY CONSERVATION MEASURE, INDICATE WHETHER IT HAS ALREADY BEEN DONE, CONSIDERED, OR NOT UNDERSTOOD

BY INCOME LEVEL

SET BACK THERMOSTAT AT NITE***

	LESS THAN $14,000 %	$14,000 - $25,999 %	$26,000 AND OVER %
TOTAL SAMPLE (n= 950)	37.2	37.3	25.6
Already Done (n= 857)	34.1	38.3	27.7
Would Consider (n= 75)	61.3	30.7	8.0
Not Understood (n= 18)	83.3	16.7	-

*** Chi-square statistic significant at the 0.001 level

EXHIBIT 20.9

FOR EACH ENERGY CONSERVATION MEASURE, INDICATE WHETHER IT HAS ALREADY BEEN DONE, CONSIDERED, OR NOT UNDERSTOOD

BY INCOME LEVEL

HAVE FURNACE TUNED AND UPGRADED***

	LESS THAN $14,000 %	$14,000 - $25,999 %	$26,000 AND OVER %
TOTAL SAMPLE (n= 726)	38.2	37.7	24.1
Already Done (n= 438)	32.2	40.2	27.6
Would Consider (n= 229)	45.4	34.9	19.7
Not Understood (n= 59)	54.2	30.5	15.3

*** Chi-square statistic significant at the 0.001 level

EXHIBIT 20.10

FOR EACH ENERGY CONSERVATION MEASURE, INDICATE WHETHER IT HAS ALREADY BEEN DONE, CONSIDERED, OR NOT UNDERSTOOD

BY INCOME LEVEL

ADD INSULATION TO ATTIC

	LESS THAN $14,000 %	$14,000 - $25,999 %	$26,000 AND OVER %
TOTAL SAMPLE (n= 909)	38.0	36.9	25.2
Already Done (n= 770)	39.6	35.5	24.9
Would Consider (n= 135)	28.9	44.4	26.7
Not Understood (n= 4)	25.0	50.0	25.0

EXHIBIT 20.11

FOR EACH ENERGY CONSERVATION MEASURE, INDICATE WHETHER IT HAS ALREADY BEEN DONE, CONSIDERED, OR NOT UNDERSTOOD

BY INCOME LEVEL

ADD INSULATION TO WALLS

	LESS THAN $14,000 %	$14,000 - $25,999 %	$26,000 AND OVER %
TOTAL SAMPLE (n= 785)	38.1	36.8	25.1
Already Done (n= 593)	40.6	35.4	23.9
Would Consider (n= 188)	30.9	40.4	28.7
Not Understood (n= 4)	-	75.0	25.0

EXHIBIT 20.12

FOR EACH ENERGY CONSERVATION MEASURE, INDICATE WHETHER IT HAS ALREADY BEEN DONE, CONSIDERED, OR NOT UNDERSTOOD

BY INCOME LEVEL

ADD INSULATION TO BASEMENT

	LESS THAN $14,000 %	$14,000 - $25,999 %	$26,000 AND OVER %
TOTAL SAMPLE (n=770)	36.4	36.5	27.1
Already Done (n=527)	37.0	36.1	26.9
Would Consider (n=238)	34.5	37.8	27.7
Not Understood (n=5)	60.0	20.0	20.0

EXHIBIT 20.13

FOR EACH ENERGY CONSERVATION MEASURE, INDICATE WHETHER IT HAS ALREADY
BEEN DONE, CONSIDERED, OR NOT UNDERSTOOD
BY INCOME LEVEL
ADD WEATHER STRIP TO DOORS

	LESS THAN $14,000 %	$14,000 - $25,999 %	$26,000 AND OVER %
TOTAL SAMPLE (n= 964)	38.6	36.4	25.0
Already Done (n= 759)	39.3	35.8	24.9
Would Consider (n= 199)	35.7	39.2	25.1
Not Understood (n= 6)	50.0	16.7	33.3

EXHIBIT 20.14

FOR EACH ENERGY CONSERVATION MEASURE, INDICATE WHETHER IT HAS ALREADY BEEN DONE, CONSIDERED, OR NOT UNDERSTOOD

BY INCOME LEVEL

ADD WEATHER STRIP TO WINDOWS

	LESS THAN $14,000 %	$14,000 - $25,999 %	$26,000 AND OVER %
TOTAL SAMPLE (n= 884)	38.5	36.1	25.5
Already Done (n= 656)	38.9	36.3	24.8
Would Consider (n= 221)	37.6	36.2	26.2
Not Understood (n= 7)	28.6	14.3	57.1

EXHIBIT 20.15

FOR EACH ENERGY CONSERVATION MEASURE, INDICATE WHETHER IT HAS ALREADY BEEN DONE, CONSIDERED, OR NOT UNDERSTOOD

BY INCOME LEVEL

ADD WEATHER STRIP TO ATTIC HATCH

	LESS THAN $14,000 %	$14,000 - $25,999 %	$26,000 AND OVER %
TOTAL SAMPLE (n= 721)	38.3	35.6	26.1
Already Done (n= 418)	40.0	34.9	25.1
Would Consider (n= 292)	36.0	36.6	27.4
Not Understood (n= 11)	36.4	36.4	27.3

EXHIBIT 20.16

FOR EACH ENERGY CONSERVATION MEASURE, INDICATE WHETHER IT HAS ALREADY BEEN DONE, CONSIDERED, OR NOT UNDERSTOOD

BY INCOME LEVEL

ADD CHAULKING IN CRACKS

	LESS THAN $14,000 %	$14,000 - $25,999 %	$26,000 AND OVER %
TOTAL SAMPLE (n= 922)	38.4	36.9	24.7
Already Done (n= 595)	40.3	35.1	24.5
Would Consider (n= 298)	35.6	39.6	24.8
Not Understood (n= 29)	27.6	44.8	27.6

EXHIBIT 20.17

FOR EACH ENERGY CONSERVATION MEASURE, INDICATE WHETHER IT HAS ALREADY BEEN DONE, CONSIDERED, OR NOT UNDERSTOOD

BY INCOME LEVEL

INSTALL STORM WINDOWS

	LESS THAN $14,000 %	$14,000 - $25,999 %	$26,000 AND OVER %
TOTAL SAMPLE (n=925)	38.7	37.0	24.3
Already Done (n=653)	39.8	36.9	23.3
Would Consider (n=260)	36.5	37.3	26.2
Not Understood (n=12)	25.0	33.3	41.7

EXHIBIT 20.18

FOR EACH ENERGY CONSERVATION MEASURE, INDICATE WHETHER IT HAS ALREADY BEEN DONE, CONSIDERED, OR NOT UNDERSTOOD

BY INCOME LEVEL

INSTALL DOMESTIC SOLAR HOT WATER SYSTEM

	LESS THAN $14,000 %	$14,000 - $25,999 %	$26,000 AND OVER %
TOTAL SAMPLE (n=803)	37.1	38.2	24.7
Already Done (n=31)	51.6	32.3	16.1
Would Consider (n=365)	35.9	35.9	28.2
Not Understood (n=407)	37.1	40.8	22.1

EXHIBIT 20.19

FOR EACH ENERGY CONSERVATION MEASURE, INDICATE WHETHER IT HAS ALREADY BEEN DONE, CONSIDERED, OR NOT UNDERSTOOD

BY INCOME LEVEL

INSTALL WOOD STOVE***

	LESS THAN $14,000 %	$14,000 - $25,999 %	$26,000 AND OVER %
TOTAL SAMPLE (n= 869)	38.6	38.1	23.4
Already Done (n= 497)	48.1	33.8	18.1
Would Consider (n= 345)	24.1	45.5	30.4
Not Understood (n= 27)	48.1	22.2	29.6

*** Chi-square statistic significant at the 0.001 level

EXHIBIT 20.20

FOR EACH ENERGY CONSERVATION MEASURE, INDICATE WHETHER IT HAS ALREADY BEEN DONE, CONSIDERED, OR NOT UNDERSTOOD

BY INCOME LEVEL

REDUCE TEMPERATURE SETTING ON HOT WATER*

	LESS THAN $14,000 %	$14,000 - $25,999 %	$26,000 AND OVER %
TOTAL SAMPLE (n= 888)	37.0	37.0	25.9
Already Done (n= 476)	33.8	37.2	29.0
Would Consider (n= 358)	39.4	38.3	22.3
Not Understood (n= 54)	50.0	27.8	22.2

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* Chi-square statistic significant at the 0.05 level

EXHIBIT 20.21

FOR EACH ENERGY CONSERVATION MEASURE, INDICATE WHETHER IT HAS ALREADY BEEN DONE, CONSIDERED, OR NOT UNDERSTOOD

BY INCOME LEVEL

DRY CLOTHES OUTDOORS*

	LESS THAN $14,000 %	$14,000 - $25,999 %	$26,000 AND OVER %
TOTAL SAMPLE (n=972)	39.0	36.7	24.3
Already Done (n=893)	40.5	35.9	23.5
Would Consider (n=75)	20.0	46.7	33.3
Not Understood (n=4)	50.0	25.0	25.0

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* Chi-square statistic significant at the 0.05 level

EXHIBIT 21

EXTENT OF PARTICIPATION IN CHIP AND COSP BY INCOME LEVEL

	LESS THAN $14,000 %	$14,000 - $25,999 %	$26,000 AND OVER %
CHIP Grant (n=535)	44.3	34.4	21.3
COSP Grant (n=72)	43.1	36.1	20.8

EXHIBIT 22

CONSERVATION MEASURES TAKEN BY PARTICIPATION IN CHIP*
(n=518)

	PERCENTAGE
Insulation-Walls	17.4
Insulation-Attic	51.4
Airtightening	1.1
Walls & Attic	21.8
Walls & Airtightening	1.0
Attic & Airtightening	3.5
All Three	3.9

CONSERVATION MEASURES TAKEN BY PARTICIPATION IN COSP*
(n=77)

	PERCENTAGE
Insulation-Walls	22.1
Insulation-Attic	24.7
Purchase Wood Stove	77.9
Oil Furnace Retrofit	1.3
Airtightening	6.5
Solar System	-
Other	3.9

*Totals may exceed 100% due to multiple mentions

EXHIBIT 23

ARE CHIP AND COSP SUFFICIENT
BY INCOME LEVEL***

	LESS THAN $14,000 %	$14,000 - $25,999 %	$26,000 AND OVER %
TOTAL SAMPLE (n=936)	38.4	36.8	24.9
Yes (n=338)(35.8%)**	39.6	37.3	23.1
No (n=117)(12.4%)**	24.8	32.5	42.7
Not Sure/Don't Know (n=481)(51.8%)**	40.7	37.4	21.8

INCOME LEVEL***BY "ARE CHIP AND
COSP SUFFICIENT"

	YES %	NO %	NOT SURE %
TOTAL			
Less than $14,000 (n=359)(38.4%)	37.3	8.1	54.6
$14,000-$25,999 (n=344)(36.8%)	36.6	11.0	52.3
$26,000 and over (n=233)(24.9%)	33.5	21.5	45.1

** Percentages of total responses were taken from questionnaire frequencies in Appendix A.

*** Chi-square statistic significant at the 0.001 level

EXHIBIT 24

FOR RESPONDENTS WHO HAVE RECEIVED A GRANT FROM CHIP, ARE YOU CONSIDERING TAKING ADVANTAGE OF ONE OF THE GOVERNMENT PROGRAMS,CHIP OR COSP,BY INCOME LEVEL

	LESS THAN $14,000 %	$14,000 - $25,999 %	$26,000 AND OVER %
TOTAL SAMPLE (n=433)	45.5	32.6	21.9
Yes (n=194) (44.8%)*	47.4	30.4	22.2
No (n=239)(55.2%)*	43.9	34.3	21.8

INCOME LEVEL BY RESPONDENTS WHO HAVE RECEIVED GRANT FROM CHIP, CONSIDERING TAKING ADVANTAGE OF ONE OF THE GOVERNMENT PROGRAMS, CHIP OR COSP

	YES %	NO %
Less than $14,000 (n=197)(45.5%)	46.7	53.3
$14,000-$25,999 (n=141)(32.6%)	41.8	58.2
$26,000 and over (n=95) (21.9%)	45.3	54.7

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* Percentages of total responses taken from questionnaire frequencies in Appendix A.

EXHIBIT 24
(continued)

FOR RESPONDENTS WHO HAVE RECEIVED A GRANT FROM COSP, ARE YOU CONSIDERING TAKING ADVANTAGE OF ONE OF THE GOVERNMENT PROGRAMS, CHIP OR COSP, BY INCOME LEVEL

	LESS THAN $14,000 %	$14,000 - $25,999 %	$26,000 AND OVER %
TOTAL SAMPLE (n=51)	41.2	37.3	21.6
Yes (n=26) (51.0%)*	38.5	42.3	19.2
No (n=25)(49.0%)*	44.0	32.0	24.0

INCOME LEVEL BY RESPONDENTS WHO HAVE RECEIVED A GRANT FROM COSP, CONSIDERING TAKING ADVANTAGE OF ONE OF THE GOVERNMENT PROGRAMS, CHIP OR COSP

	YES %	NO %
Less than $14,000 (n=21)(41.2%)	47.6	52.4
$14,000-$25,999 (n=19)(37.3%)	57.9	42.1
$26,000 and over (n=11)(21.6%)	45.5	54.5

* Percentages of total responses were taken from questionnaire frequencies in Appendix A.

EXHIBIT 25

EXTENT OF FUNDING NEEDED TO BRING THE HOME TO AN ACCEPTABLE LEVEL OF ENERGY EFFICIENCY BY AGE OF HOUSE

	BEFORE 1945 %	1945-1960 %	1961-1970 %	AFTER 1970 %
TOTAL SAMPLE (n=798)	18.4	21.2	23.1	37.3
$500 or less (n=135)	15.6	14.8	19.3	50.4
$501 - $750 (n=77)	7.8	20.8	14.3	57.1
$751 - $1,000 (n=160)	18.8	21.9	21.9	37.5
$1,001 - $1,500 (n=105)	18.1	18.1	25.7	38.1
$1,501 - $2,500 (n=134)	20.9	26.9	21.6	30.6
More than $2,500 (n=187)	23.0	23.0	29.9	24.1

AGE OF HOUSE BY EXTENT OF FUNDING NEEDED TO BRING THE HOME TO AN ACCEPTABLE LEVEL OF ENERGY EFFICIENCY

	$500 or less %	$501-$750 %	$751-$1000 %	$1001-$1500 %	$1501-$2500 %	MORE TH $25
Before 1945 (n=147)(18.4%)	14.3	4.1	20.5	12.9	19.0	2[illegible].
1945-1960 (n=169)(21.2%)	11.8	9.5	20.7	11.2	21.3	25.
1961-1970 (n=184)(23.1%)	14.2	6.0	19.0	14.7	15.7	3[illegible].
After 1970 (n=298)(37.3%)	22.8	14.7	20.1	13.4	13.8	15.

EXHIBIT 26

LENGTH OF TIME CONSIDERED ACCEPTABLE FOR RETROFIT PAYBACK BY INCOME LEVEL

	LESS THAN $14,000 %	$14,000 - $25,999 %	$26,000 AND OVER %
TOTAL SAMPLE (n=881)	38.0	36.4	25.5
Less than 2 years (n=210) (24.0%)*	39.0	34.8	26.2
2 to 5 years (n=515) (58.2%)*	37.7	38.4	23.9
6 to 7 years (n=77) (8.9%)*	32.5	41.6	26.0
8 to 10 years (n=79) (8.9%)*	43.0	22.8	34.2

INCOME LEVEL BY LENGTH OF TIME CONSIDERED ACCEPTABLE FOR RETROFIT PAYBACK

	LESS THAN 2 YEARS %	2 TO 5 YEARS %	6 TO 7 YEARS %	8 TO 10 YEARS %
Less than $14,000 (n=335) (38.0%)	24.5	57.9	7.5	10.1
$14,000-$25,999 (n=321) (36.4%)	22.7	61.7	10.0	5.6
$26,000 and over (n=225) (25.5%)	24.4	54.7	8.9	12.0

* Percentages of total responses were taken from questionnaire frequencies in Appendix A.

EXHIBIT 27

WILLINGNESS TO PAY FOR AUDIT SERVICES BY INCOME LEVEL*

	LESS THAN $14,000 %	$14,000 - $25,999 %	$26,000 AND OVER %
TOTAL SAMPLE (n=646)	34.7	37.8	27.6
Yes (n=317) (48.7%)**	30.6	36.9	32.5
No (n=329) (51.3%)**	38.6	38.6	22.8

INCOME LEVEL* BY WILLINGNESS TO PAY FOR AUDIT SERVICES

	YES %	NO %
Less than $14,000 (n=224)(34.7%)	43.3	56.7
$14,000-$25,999 (n=244)(37.8%)	48.0	62.0
$26,000 and over (n=178)(27.6%)	57.9	42.1

* Chi-square statistic significant at the 0.05 level.

** Percentages of total responses were taken from questionnaire frequencies in Appendix A.

EXHIBIT 27
(Continued)

IF WILLING TO PAY FOR AUDIT SERVICES, WILLINGNESS TO PAY $60 FOR THE AUDIT BY INCOME LEVEL*

	LESS THAN $14,000 %	$14,000 - $25,999 %	$26,000 AND OVER %
TOTAL SAMPLE (n=310)	30.6	36.8	32.6
Yes (n=113) (35.9%)**	23.0	38.1	38.9
No (n=61) (20.9%)**	24.6	37.7	37.7
Not Sure/Don't Know (n=136) (43.0%)**	39.7	35.3	25.0

INCOME LEVEL* BY WILLINGNESS TO PAY $60 FOR THE AUDIT

	YES %	NO %	NOT SURE/ DON'T KNOW %
Less than $14,000 (n=95)(30.6%)	27.4	15.8	56.8
$14,000-$25,999 (n=114)(36.8%)	37.7	20.2	42.1
$26,000 and Over (n=101)(32.6)	43.6	22.8	33.7

* Chi-square statistic significant at the 0.05 level.

** Percentages of total responses were taken from questionnaire frequencies in Appendix A.

EXHIBIT 28

ATTITUDES TOWARDS ENERGY CONSERVATION BY INCOME LEVEL

STATEMENT	LESS THAN $14,000			$14,000-$25,999			$26,000 AND OVER		
	AGREE %	NEUTRAL %	DISAGREE %	AGREE %	NEUTRAL %	DISAGREE %	AGREE %	NEUTRAL %	DISAGR %
1. Everyone should try to reduce their energy consumption (n=995)	97.7	2.3	-	98.1	1.6	0.3	98.8	0.8	0.4
2. A house that is well insulated is easier to sell (n=990)**	83.9	13.3	2.9	81.3	17.6	1.1	89.3	9.5	1.2
3. When I leave the house for any period of time, I turn the thermostat down (n=969)*	85.6	9.0	5.4	91.4	3.9	4.7	92.1	4.6	3.3
4. The initial cost of insulation is too high in relation to the amount I will save later (n=977)***	24.2	28.5	47.3	13.3	31.9	54.8	14.3	16.8	68.9
5. The cost of fuel and electricity will not rise as rapidly over the next few years (n=984)	8.9	28.2	62.9	9.9	28.5	61.6	9.1	20.7	70.2
6. An energy efficient home is worth a lot more if the time comes that you want to sell it (n=989)	81.1	16.5	2.4	78.6	18.4	3.0	83.2	13.9	2.9
7. There's lots of electricity and oil around (n=977)***	45.5	33.2	21.3	41.5	33.3	25.1	44.4	21.4	34.2
8. By insultating a house, you make it more comfortable to to live in (n=991)	95.6	3.4	1.0	96.2	2.2	1.6	96.3	2.9	0.8

EXHIBIT 28 (Continued)

ATTITUDES TOWARDS ENERGY CONSERVATION BY INCOME LEVEL

STATEMENT	LESS THAN $14,000			$14,000-$25,999			$26,000 AND OVER		
	AGREE %	NEUTRAL %	DISAGREE %	AGREE %	NEUTRAL %	DISAGREE %	AGREE %	NEUTRAL %	DISAGREE %
9. It is possible for me to save energy without much trouble (n=989)*	60.5	24.6	14.9	62.8	19.6	17.6	63.9	15.6	20.5
10. There is not enough information available on how to conserve energy in the home (n=990)***	36.0	36,3	27.7	29.8	31.1	39.1	22.5	23.0	54.5

* Chi-square statistic significant at the 0.05 level
** Chi-square statistic significant at the 0.01 level
*** Chi-square statistic significant at the 0.001 level

INCOME BY TYPE OF DWELLING LIVED IN

	SINGLE DETACHED %	OTHER %
TOTAL SAMPLE (n=678)	86.7	13.3
$14,000 or less (n=234)	89.7	10.3
$14,000 - $25,999 (n=257)	82.9	17.1
$26,000 and over (n=187)	88.2	11.8

SQUARE FEET OF LIVING SPACE BY HOUSING TYPE*

	SINGLE DETACHED %	OTHER %
TOTAL SAMPLE (n=922)	87.2	12.8
Less than 900 (n=302)	83.4	16.6
900 - 1200 (n=388)	90.5	9.5
1201 - 1500 (n=125)	88.0	12.0
More than 1500 (n=107)	85.0	15.0

* Chi-square statistic significant at the 0.05 level

PRINCIPLE HEATING SOURCE BY DWELLING TYPE

	SINGLE DETACHED %	OTHER %
TOTAL SAMPLE (n=1002)	84.8	15.2
Electric (n=322)	75.2	24.8
Oil Furnace (Hot Water) (n=131)	84.7	15.3
Oil Furnace (Warm Air) (n=181)	82.9	17.1
Wood Stove or Furnace (n=246)	95.5	4.5
Other (n=122)	91.8	8.2

APPENDIX III

SOCIAL SURVEY QUESTIONNAIRE AND FREQUENCY ANALYSIS

omnifacts research limited

If you have moved or your address is incorrect, please write in new address:

____

____

____

____

____

____

____

____

This questionnaire concerns energy and energy conservation. We are interested in the type and size of dwelling in which you live, the type and amount of fuel you use to heat your home and hot water, your opinion of various energy conservation measures and government programs available and also the energy conservation measures you have taken or intend to take in your home.

1. When was your home built?

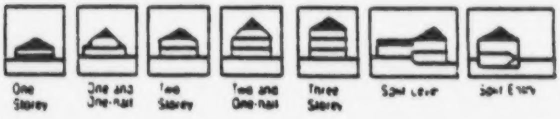
Before 1945...n=185.....☐1 18.2% 1961 - 1970..n=230........☐3 22.6% 2/6
1945 - 1960...n=229.......☐2 22.5% After 1970...n=375........☐4 36.8%

2. What type of dwelling do you live in?

Single detached...n=875..........................☐1 85.1%
Semi detached.....n=39...........................☐2 3.8%
Rowhouse (3 or more units attached).n=53.........☐3 5.2% 7
Apartment...n=24.................................☐4 2.3%
Mobile home..n=32................................☐5 3.1%
Other (Please Specify) n=5 ___________...☐ 0.5%

3. How many storeys does your dwelling have? (A basement or crawl space should not be considered a storey)

One storey..n=632..................☐1 60.8%
One and a half storeys.n=47........☐2 4.5%
Two storeys..n=262.................☐3 25.2% 8
Two and a half storeys.n=11........☐4 1.1%
Three storeys..n=17................☐5 1.6%
Split level....n=43................☐6 4.1%
Split entry....n=27................☐7 2.6%



4. How many finished rooms are in your dwelling? (Do not include bathrooms, hallways, vestibules)

WRITE IN NUMBER ____________ See Tables Attached 9—1

5. How many square feet of living space do you have in your dwelling? (Do not include basement)

PLEASE WRITE IN NUMBER ____________ Sq. ft. 11—

If not sure, please provide dimensions of your dwelling.

1st level ________ feet by ______ feet

2nd level (if applicable) ______ feet by _____ feet

3rd level (if applicable) ______ feet by _____ feet

	n	%
<900 sq. ft.	302	32.8
909-1200	388	42.1
1201-1500	125	13.6
>1500	107	11.6

6a. Please indicate the main source of heating in your home. (CHECK ONLY ONE) 15

Electric - Electric Baseboard	n=300	[ ]1	29.5%
- Electric Furnace (Hot Water)	n=12	[ ]2	1.2%
- Electric Furnace (Warm Air)	n=12	[ ]3	1.2%
Oil Furnace (Hot Water)	n=132	[ ]4	13.0%
Oil Furnace (Warm Air)	n=184	[ ]5	18.1%
Oil Stove	n=37	[ ]6	3.6%
Wood Stove	n=186	[ ]7	18.3%
Wood Furnace	n=65	[ ]8	6.4%
Other (Please Specify)________	n=90	[ ]9	8.8%

b. If you use wood as your main source of heating, how do you obtain your supply of wood? 16

Purchase from a Friend or Neighbour	n=7	[ ]1	1.8%
Purchase from a Fuel Wood Supplier	n=6	[ ]2	1.6%
Purchase Waste Wood from a Sawmill	n=3	[ ]3	0.8%
Cut by Myself or other Family Member	n=362	[ ]4	94.5%
Other (Please Specify)________	n=5	[ ]	1.3%

c. If you do not use wood as your main source of heating, please indicate the main reason why not? (CHECK ONLY ONE) 17

Too Expensive	n=47	[ ]1	8.7%
Too Messy too Handle	n=34	[ ]2	6.3%
Too Difficult to Find and Transport	n=145	[ ]3	27.0%
No Wood Supplier in my Area	n=24	[ ]4	4.5%
Other (Please Specify)________	n=288	[ ]	53.5%

7. Please indicate how your hot water is heated. (CHECK ONLY ONE) 18

Electric Hot Water Heater	n=748	[ ]1	73.4%
Water Heated by Oil Furnace	n=156	[ ]2	15.3%
Water Heater Connected to Oil Stove	n=16	[ ]3	1.6%
Water Heater Connected to Wood Stove	n=23	[ ]4	2.2%
Propane Hot Water Heater	n=6	[ ]5	0.6%
Solar	n=0	[ ]6	0.0%
Other (Please Specify)________	n=31	[ ]7	3.0%
None	n=39	[ ]8	3.8%

8a. Have you made any renovations to your dwelling during the past seven years which have increased its size, i.e. added a room, increased the size of existing rooms, etc.?

24.6% 75.4%

YES n=248. [ ]1 NO. n=759 [ ]2 If No, Go to Q. 9 19

b. If yes, were these renovations done by yourself, your family or friends or by a paid contractor? (CHECK MORE THAN ONE IF NECESSARY)

Myself. n=121 .... [ ]1 48.0%
Family or Friends n=60 [ ]2 23.8%
Contractor. n=29 ...... [ ]3 11.5%
Landlord.. n=6 .... [ ]4 2.4%
Other... n=36 .... 14.3% 20

Comments:

SEE ATTACHED LISTINGS

c. Approximately how much money did you spend on these renovations?

Less than $250. n=4 ...... [ ]1 1.6%
$250 to $500... n=18 ..... [ ]2 7.2%
$500 to $1000.. n=55 ..... [ ]3 21.9%
$1000 to $2500. n=78 ...... [ ]4 31.1%
$2500 to $5000. n=45 ...... [ ]5 17.9%
More than $5000... n=51 ... [ ]6 20.3% 21

9a. During the last 12 months, what was the total cost of the fuel used to heat your home? (Include cost of all types of fuel used to heat your home - oil, electricity, wood, etc.)

$200 or less n=100 .... [ ]1 10.3%
$201 to $400. n=85 .... [ ]2 8.8%
$401 to $500. n=47 .... [ ]3 4.8%
$501 to $600. n=55 .... [ ]4 5.7%
$601 to $700 n=68 .... [ ]5 7.0
$701 to $800.. n=94 .... [ ]6 9.7%
$801 to $1000. n=152 ..... [ ]7 15.7%
$1001 to $1200 n=128 ..... [ ]8 13.2%
$1201 to $1400 n=113 ..... [ ]9 11.6%
More than $1400. n=128 .... [ ]1 13.2% 22-3

b. If your home is not electrically heated, what were your electricity costs for the past 12 months? (n=660)

$100 or less.. n=26 ...... [ ]1 3.9%
$101 to $200.. n=47 ...... [ ]2 7.1%
$201 to $300.. n=99 ...... [ ]3 15%
$301 to $400.. n=169 ..... [ ]4 25.6%
$401 to $500. n=152 .... [ ]5 23.0%
$501 to $600. n=73 .... [ ]6 11.1%
$601 to $750. n=59 .... [ ]7 8.9%
More than $750. n=34 ...... [ ]8 5.2% 24

10a. Do you have more than one thermostat or heat control unit in your home?

46.2% 53.8%

YES. n=467 [ ]1 .NO n=543. [ ]2 If No, Go to Q. 11 25

b. If yes, in the winter, do you use these thermostats to reduce the heat in some of the rooms or close off some of the rooms in your home?

79.3% 20.7%

YES. n=368 [ ]1 NO. n=96. [ ]2 If No, Go to Q. 11 26

c. If yes, how many rooms in the heated area of your home are not fully heated? (Rooms should be considered not fully heated if they are left much cooler than the average temperature during the day of your home)

%

None.... n=52 .... [ ]1 14.4
One..... n=37 .... [ ]2 10.2
Two..... n=75 .... [ ]3 20.7%
Three.. n=129 .... [ ]4 35.6%
Four or More. n=69 .... [ ]5 19.1% 27

11. The statements in this question are all concerned with energy. Please indicate, by checking the appropriate box, the extent to which you agree or disagree with each statement. Check one box for each statement. The meaning of each box is as follows:

The first box means you definitely agree with the statement,
The second box means you generally agree with the statement,
The third box means you neither agree nor disagree with the statement,
The fourth box means you generally disagree with the statement,
The fifth box means you definitely disagree with the statement.

	DEFINITELY AGREE	GENERALLY AGREE	NEITHER AGREE NOR DISAGREE	GENERALLY DISAGREE	DEFINITELY DISAGREE	
a) Everyone should be trying to reduce their enery consumption.	n=811 [ ] 78.3%	n=206 [ ] 19.9%	n=17 [ ] 1.6%	n=2 [ ] .2%	n=--- [ ]	28
b) A house that is well insulated is easier to sell..............	n=522 [ ] 50.6%	n=347 [ ] 33.7%	n=144 [ ] 13.9%	n=12 [ ] 1.2%	n=6 [ ] .6%	29
c) When I leave the house for any period of time, I turn the thermostat down.................	n=682 [ ] 67.6%	n=221 [ ] 21.9%	n=59 [ ] 5.8%	n=35 [ ] 3.5%	n=12 [ ] 1.2%	30
d) The initial cost of insulation is too high in relation to the amount I will save later.......	n=63 [ ] 6.2%	n=119 [ ] 11.7%	n=270 [ ] 26.5%	n=312 [ ] 30.7%	n=253 [ ] 24.9%	31
e) The cost of fuel and electricity will not rise as rapidly over the next few years.	n=28 [ ] 2.7%	n=68 [ ] 6.6%	n=273 [ ] 26.7%	n=350 [ ] 34.2%	n=305 [ ] 29.8%	32
f) An energy efficient home is worth a lot more if the time comes that you want to sell it.	n=443 [ ] 43.0%	n=387 [ ] 37.6%	n=172 [ ] 16.7%	n=17 [ ] 1.7%	n=11 [ ] 1.1%	33
g) There's lots of electricity and oil around.................	n=165 [ ] 16.2%	n=286 [ ] 28.1%	n=304 [ ] 29.9%	n=173 [ ] 16.9%	n=90 [ ] 8.8%	34
h) By insulating a house, you make it more comfortable to live in.	n=676 [ ] 65.5%	n=313 [ ] 30.3%	n=31 [ ] 3.0%	n=4 [ ] .9%	n=3 [ ] .3%	35
i) It is possible for me to save energy without much trouble....	n=213 [ ] 20.7%	n=428 [ ] 41.6%	n=212 [ ] 20.6%	n=137 [ ] 13.3%	n=40 [ ] 3.9%	36
j) There is not enough information available on how to conserve energy in the home.............	n=107 [ ] 10.4%	n=203 [ ] 19.7%	n=320 [ ] 31.0%	n=290 [ ] 28.1%	n=111 [ ] 10.8%	37
	1	2	3	4	5	

12. Which of the following energy conservation methods have you tried or would try to reduce energy consumption in your home?

	ALREADY DONE	WOULD CONSIDER DOING THIS	DO NOT UNDERSTAND THIS METHOD	
a) Turning off lights and appliances when they are not being used	n=1001 [ ] 96.4%	n=37 [ ] 3.6%	-- [ ] --	38
b) Avoiding ice build-up in the freezer compartment of your refrigerator and keeping the cooling coils clean	n=770 [ ] 75.2%	n=218 [ ] 21.3%	n=36 [ ] 3.5%	39
c) Ensuring freezers are full to operate at the greatest efficiency	n=462 [ ] 46.8%	n=353 [ ] 35.8%	n=172 [ ] 17.4%	40
d) Closing off portions of your home during the heating season	n=424 [ ] 45.1%	n=396 [ ] 42.1%	n=120 [ ] 12.8%	41
e) Using cool temperature wash cycles in your washing machine	n=710 [ ] 70.5%	n=271 [ ] 26.9%	n=26 [ ] 2.6%	42
f) Installing hot water flow restrictors in faucets and showerheads	n=120 [ ] 12.6%	n=604 [ ] 63.6%	n=225 [ ] 23.7%	43
g) Setting back the thermostat at night	n=895 [ ] 90.2%	n=78 [ ] 7.9%	n=19 [ ] 1.9%	44
h) Having your furnace tuned and upgraded for greater efficiency	n=466 [ ] 61.3%	n=234 [ ] 30.3%	n=60 [ ] 7.9%	45
i) Adding insulation to:				
- attic	n=802 [ ] 84.7%	n= [139] 14.7%	n= [6] .6%	46
- walls	n=613 [ ] 74.9%	[200] 24.4%	[5] .6%	47
- basement	n=545 [ ] 68.0%	[249] 31.1%	[7] .9%	48
j) Adding weatherstripping to:				
- doors	n=791 [ ] 78.9%	n= [206] 20.5%	n= [6] .6%	49
- windows	n=682 [ ] 74.3%	[229] 24.9%	[7] .8%	50
- attic hatch	n=428 [ ] 57.3%	[306] 41.0%	[12] 1.6%	51
k) Adding caulking in cracks between building materials	n= [617] 64.3%	n= [312] 32.5%	n= [30] 3.1%	52
l) Installing storm windows	n= [684] 71.0%	n= [267] 27.7%	n= [12] 1.2%	53
m) Installing a domestic solar hot water system	n= [32] 3.9%	n= [377] 45.4%	n= [422] 50.8%	54
n) Installing a wood stove	n= [510] 56.6%	n= [361] 40.1%	n= [30] 3.3%	55
o) Reducing the temperature setting on hot water heater	n= [499] 53.9%	n= [371] 40.1%	n= [55] 5.9%	56
p) Drying clothes outdoors	n= [926] 91.7%	n= [80] 7.9%	n= [4] .4%	57
	1	2	3	

13 a. Have you ever received a grant from the Canadian Home Insulation Program (CHIP)?

54.4% 45.6%

YES. n=555 [ ]₁ NO. n=466 [ ]₂ If No, Go to Q. 13(d) 58

b. If yes, what energy conservation measures did you take? (CHECK MORE THAN ONE IF APPROPRIATE)

Insulation of Walls or Basement..............[ ] 17.4%
Insulation of Attic..........................[ ] 51.4% 59
Airtightening................................[ ] 1.1%

SEE OUTPUT TABLES

c. If yes, how long did it take your CHIP application to arrive?

Less than One Week. n=49 ....[ ]1 8.4%
1 - 2 Weeks........ n=137 ....[ ]2 25% 60
More than 2 Weeks.. n=362 ....[ ]3 66.1%

d. If no, why have you not applied for the CHIP grant? (n=425)

No Knowledge of Program.................[ ]1 13.3%
Do Not Know how to Apply..............[ ]2 10.4% 61
Too Expensive.........................[ ]3 11.6%
Other (Please Specify)________________.[ ]
Applying Now 5.4%
Renting 10.1%
All Readywell Insulated 24.2%
Not Eligible 8.1%
Not Interested 6.7%
Other 10.1%

14. The Federal Government has introduced the Canadian Oil Substitution Program (COSP) in which a homeowner may receive a grant of up to $800 for one-half the cost of insulating or converting his/her oil heated home to wood, solar or peat (or to electricity in parts of Labrador). The homeowner pays an amount equal to the grant.

a. Have you ever received a grant from the Canadian Oil Substitution Program (COSP)?

7.6% ~~93.4%~~ 92.4.

YES. n=77 ...[ ]₁ NO. n=932 [ ]₂ If No, Go to Q. 14(d) 62

b. If yes, what energy conservation measures did you take? (CHECK MORE THAN ONE IF APPROPRIATE)

Insulation of Walls or Basement...........[ ] 63
Insulation of Attic.......................[ ] 64
Purchase of Wood Stove or Wood Furnace....[ ] 65
Oil Furnace Retrofit......................[ ] 66
Airtightening.............................[ ] 67
Solar System..............................[ ] 68
Other (Please Specify)_________________..[ ] 69

SEE REPORT

c. If yes, how long did it take you to receive your COSP application?

Less than One Week. n=1 ....[ ]1 1.4%
1 - 2 Weeks........ n=9 ....[ ]2 12.3% 70
More than 2 Weeks.. n=63 ....[ ]3 86.3%

d. If no, why have you not applied for the COSP grant? (n=843)

No Knowledge of Program................[ ]1 33.9%
Do Not Know how to Apply...............[ ]2 8.7% 71
Too Expensive..........................[ ]3 12.9%
Other (Please Specify)_________________.[ ]
Not Eligible - 10.4%
Not Interested - 9.3%
Renting - 4.0%
Already had Wood - 6.0%
No facilities for woodstove/
No wood - 1.3%
Other - 13.4%

.or COSP, in the future to help reduce your household energy bill? 72

YES.n=348 [ ]1 38.8% NO.n=548 [ ]2 61.2%

16. Do you feel that the grants now available to you through the CHIP and COSP programs are sufficient to reduce your home energy costs significantly? 73

YES.n=349 [ ]1 35.8% NO.n=121 [ ]2 12.4% NOT SURE.n=505 [ ]3 51.8%

17. If you were able to obtain additional grants or low interest loans from the government for reducing energy costs, which of the following things would you be most likely to do? 74-5

Add more Insulation..............n=179..........[ ] 19.8%
Convert to other kinds of Heat...n=202............[ ] 22.3%
Undertake Major Renovations to the House...n=250 [ ] 27.7%
Improve Furnace Efficiency or Replace Furnace...n=119 [ ] 13.2%
Combinations - 17% (n=154)

18. How much money do you think you would need to spend to bring your home to an acceptable level of energy efficiency? 76

Less than $100..n=36......[ ]1 4.2%
$100 to $250....n=31......[ ]2 3.6
$251 to $500....n=75......[ ]3 8.7
$501 to $750....n=84......[ ]4 9.8
$751 to $1000..n=171.......[ ]5 19.9%
$1001 to $1500.n=114.......[ ]6 13.3%
$1501 to $2500.n=145.......[ ]7 16.9%
More than $2500.n=202......[ ]8 23.5%

19. What length of time would you consider acceptable for the money you spend to save energy in your home to be paid back to you in savings on your energy bill? Example: If you spend $500 on insulating your house, would you expect to save $500 on your heating bill in one year or two years, etc.? 77

Less than Two Years.n=219....[ ]1 23.9%
Two to Five Years...n=531....[ ]2 51.2%
Six to Seven Years..n=81.....[ ]3 8.9%
Eight to Ten Years..n=82.....[ ]4 8.9%

20a. If a trained energy consultant was available to come into your home, examine it and give you advice on how to reduce your energy bill, would you be interested in taking advantage of this service? 78

YES n=715 [ ]1 70.4%
NO. n=300 [ ]2 If No, Go to Q. 21 29.6%

b. If yes, would you be willing to pay for this service? 79

YES n=327 [ ]1 48.7%
NO. n=344 [ ]2 51.3%

c. If yes, understanding that you would need more information about this service, do you feel that you would be willing to pay $60 for the energy saving examination? 80

YES. n=115....[ ]1 35.9%
NO.. n=67.....[ ]2 20.9%
DON'T KNOW n=138]3 43%

d. If no, how much would you be willing to pay for this service?

$________ SEE ATTACHED REPORTS

nil - (n=96) 66.7% $21-$30 - (n=15) 10.4% 31
<$10 - (n=3) 2.1% $31-$40 - (n=0) ---
$10 - $20 - (n=28) 19.4% $41-$50 (n=1) .7%
$51 - $60 (n=1) .7%

e. COMMENTS: ____________________

SEE ATTACHED LISTINGS

21. Do you own or rent your home?

OWN........[ ]$_1$ 92.2%
RENT.......[ ]$_2$ 7.8% 32

Thank you for your cooperation.

APPENDIX IV

ALTERNATIVE AUDIT PROGRAMS

Appendix IV-A

Comparative Analysis Chart of Audit Procedures Used by Agencies in the United States and Canada

APPENDIX A

COMPARATIVE ANALYSIS CHART OF AUDIT PROCEDURES USED BY AGENCIES IN THE UNITED STATES AND CANADA

The chart was prepared by examining the input data forms used by auditors for programs in North America with procedures similar to that proposed for Newfoundland. The following programs were reviewed:

- Energy Mines and Resources Canada Enerplan (P.E.I. Pilot Project)
- Consolidated Edison Energy Audit Program
- Pacific Power and Light Co. Home Energy Analysis
- State of Alaska Alaska Residential Energy Conservation Program
- Tennessee Valley Authority Home Insulation Program
- Ontario Hydro Residential Energy Advisor Program (REAP)
- Lawrence Berkeley Laboratory Computerized, Instrumental Residential Audit (CIRA)
- U.S. Department of Energy, Project Retrotech
- RISE (Rhode Islanders Saving Energy), non-profit corporation
- Massachusetts electric and gas utilities, Mass-Save, Inc.

The purpose of this overview was to determine if other procedures were being utilized elsewhere which should be adopted for this program. It was also used to determine if any appropriate aspects were consistently analyzed elsewhere that had not been included for Newfoundland. The following chart summarizes the comparison. The results are discussed on page 2 of the report.

APPENDIX B

PROCEDURES FOR ESTIMATING AIR INFILRTATION

We reviewed procedures used by several residential energy audit programs to determine if an alternative procedure to that developed in the Millbank report could be applied. Procedures reviewed and included here are from:

- Millbank
- Alaska Division of Power and Light
- Pacific Power and Light
- Tennessee Valley Authority
- U.S. Department of Energy, Project Retrotech
- Rhode Islanders Saving Energy (RISE)
- Lawrence Berkeley Laboratory, Computerized, Instrumentated Residential Audit (CIRA)

In summary we note the following characteristics of the procedures:

- Millbank relys primarily on reporting of practices which can affect humidity levels. These are in turn translated to air change estimates.
- Alaska uses an itemized list reflecting the integrity of the building envelope, the nature of the heating system, and fireplaces.
- Pacific Power and Light uses an overall measure of house construction to get an indication of air change.

- Tennessee Valley Authority does not appear to go into any depth with respect to estimates of air infiltration.
- Retrotech uses an estimate based on appearance of the integrity of the building envelope, but the assumed air changes are too high for Canadian conditions, based on recent studies.
- RISE procedures appear most comprehensive, taking into account the building envelope as well as the heating system and daily number of entry and exits by occupants.
- CIRA procedure is very complex and no figures have been developed for the range of conditions that are found in Newfoundland. The added complexity does not necessarily mean increased accuracy.

The relevant sheets describing the air infiltration estimate approach for each of the above program are attached.

Appendix IV-B

Procedures for Estimating Air Infiltration

MILLBANK

GENERAL INFORMATION

CLIENT IDENTIFICATION

NAME			
ADDRESS		DATE	
PHONE		TIME	
		(ADVISER)	

RESIDENCE IDENTIFICATION

TYPE OF HOME		SINGLE		SEMI DETACHED		DUPLEX		TRIPLEX		ROW		
YEAR OF CONSTRUCTION		BEFORE 1920		1920-45		1946-60		1961-70		AFTER 1970		
NUMBER OF STOREYS		ONE		ONE AND A HALF		TWO		TWO AND A HALF		THREE		[illegible]
WALL CONSTRUCTION		WOOD FRAME		SOLID MASONRY		SOLID LOG						
TYPE OF FOUNDATION		BASEMENT		CRAWL SPACE		SLAB ON GRADE						

CLIENT INTERVIEW

NUMBER OF RESIDENTS										
THERMOSTAT SETTINGS	DAY	EVENING	NIGHT							
DAILY DHW USE (LITRES)	20	40 GENERAL	15	WASHER (HOT CYCLE)	10	DISH WASHER	8X	BATHS PER WEEK 8X	(SHOWERS) (PER WEEK) TOTAL	
BASEMENT TEMPERATURE	20	WARM	17	COOL	15	COLD				
RESIDENT LEVEL	1	1-2	2	3-4	3	5 OR MORE	AIR CHANGE ESTIMATE			
BASEMENT HUMIDITY	1	DRY	2	COOL AND DAMP	3	WARM AND DAMP	HUMIDITY LEVEL	MOISTURE RATING 3-5	 6-8	 9-12
DRYER VENTING OR CLOTHESLINE	1	OUTDOORS	2	INDOORS SOMETIMES	3	INDOORS REGULARLY	DRY OR STATIC ELECTRICITY	.7	.8	.9
WINTER HUMIDIFIER USE	1	NONE	2	SOME	3	REGULAR	NORMAL OR LIGHT FOGGING	.5	.6	.7
MOISTURE RATING							HUMID OR HEAVY FOGGING	.3	.4	.5
REINSULATION HISTORY		REINSULATED PAST SEASON		REINSULATED PREVIOUSLY		NEVER	EXPOSURE FACTOR	1.5		
CURRENT PROBLEMS		MOISTURE		DRAFTS		COLD ROOMS	HEATING SYSTEM			
COMMENTS										

PROJECTED SPACE HEATING COST ESTIMATE

FUEL TYPE(S)	COST ESTIMATE PAST SEASON	DEGREE-DAY FACTOR	FUEL ESCALATION FACTOR	PROJECTED HEATING COST	DHW CORRECTION (IF APPLICABLE)	PROJECTED SPACE HEATING COST	TOTAL PROJECTED SPACE HEATING COST
OIL							
ELECTRICITY							
WOOD							

DETAILED FUEL OIL CONSUMPTION ESTIMATE (IF RECORDS AVAILABLE)

DELIVERY DATE		AMOUNT DELIVERED IN LITRES	CUMULATIVE DEGREE-DAYS	PROJECTED OIL HEATING COST	
DATE	YEAR				
		REFERENCE			
				FUEL CONSUMED PER DEGREE-DAY	
				AVERAGE DEGREE-DAYS	
				PROJECTED FUEL OIL PRICE	
TOTALS				PROJECTED OIL HEATING COST	

ALASKA

I ESTIMATED AIR CHANGES PER HOUR (CPH): (Infiltration or Ventilation)

POTENTIAL AIR LEAKS Enter appropriate values in columns (3) and (4) (1)		CHANGES PER HOUR (CPH) Possible (2)	Present (3)	Modified (4)
1	Uncorrected air change	0.20	0.20	0.20
2	Unsealed access to stairway installed into attic	0.05		
3	Recessed lighting fixtures installed in ceiling	0.05		
4	Air leaks in ceiling around chimney or fireplace	0.05		
5	Fireplace needs throat damper or door on front	0.05		
6	Electrical wiring and plumbing unsealed at plate	0.05		
7	Heating plant not isolated or no vent damper	0.05		
8	Poor weather stripping of doors and windows	0.05		
9	Poor caulking of window and door sash, sill, etc.	0.05		
10	Double hung window and no storm sash	0.05		
11	Poor caulking foundation rim joists, etc.	0.05		
12	Total air changes	0.70		

Air infiltration savings = Volume/55.3 X CPH

NOTE: Air change values are approximate

II HEATING COST MULTIPLIERS

Heat gain correction factor: .7

HEATING COST MULTIPLIER

$$\frac{24 \times HDD \times .7 \times \text{Unit Cost}}{\text{BTU/Unit} \times \text{Seasonal Efficiency}}$$

DESIGN TEMPERATURES (F)			Heating Degree Days
INTEMP	MTEMP	DTEMP (1) - (2)	(DCGD) (3)X365
65			
(1)	(2)	(3)	(4)

ENERGY TYPES

Heat Source	Fuel Oil Gal	Electric KWH	Coal Ton	Natural Gas CCF	Other
Gross Heat Output (GBTU)	138,000	3413	25 X 10^6	103,000	
Plant Efficiency (PCT)					
Unit Energy Costs (UCOST)					
Energy Cost Multiplier ($/BTUHF)					
	(5)	(6)	(7)	(8)	(9)

ANNUAL MEAN EXTERIOR TEMPERATURES (F)
(65 F base 365 days)

Anchorage WSB AP	35.0	Gulkana WSB AP	26.7	Northway FAA AP	22.1
Aniak FAA AP	25.2	Homer WSB	35.7	Palmer 1 N	35.7
Annette WSB AP	45.7	Juneau NB 2	42.8	Petersburg	41.9
Arctic Creek	20.8	Juneau WSB AP	38.3	Seattle, WNKD	55.3
Barrow WSB AP	9.3	Ketchikan	46.2	St. Paul Is. WSB AP	34.5
Barter Is. WSB AP	10.1	King Salmon AP	33.2	Seward	39.6
Bethel WSB AP	28.7	Kodiak WSB	40.7	Shemya WS AP	36.3
Bettles WSB AP	21.3	Kotzebue WSB AP	20.9	Sitka Magnetic OBS	42.7
Big Delta WSB AP	27.4	Little Port Walter	42.8	Summit FAA AP	25.3
Cape Decision	43.6	Matanuska WSB AP	35.2	Talkeetna WSB	32.9
Cape Spencer	42.0	McGrath WSB AP	25.2	Tanana WSB	22.5
Circle Hot Springs	22.2	McKinley Park	26.9	Unalakleet WSB	26.5
Cold Bay WSB AP	37.9	Nenana FAA AP	25.1	University Exp. Sta.	27.2
Cordova FAA AP	38.2	Palmer 1 N	35.7	Valdez	38.0
Elmendorf AFB	35.0	Portland, ME	47.5	Wrangell	43.0
Fairbanks WSB AP	25.2	Nome WSB AP	25.6	Yakutat WSB AP	38.8

47. Number of door groups

48. Type of doors
1. Standard
2. Insulated

49. Door area in square feet

50. Storm door
1. Existing
2. Should be installed or replaced
3. Not recommended

51. Door caulking
1. Good
2. Fair
3. Poor

52. Door weatherstripping
1. Good
2. Fair
3. Poor

DOOR GROUP

#1	#2	#3	#4	
				Type
				Area
				Storm Door
				Caulking
				Weatherstripping

le has ten groups

LS

53. Number of wall area groups separating living space from unconditioned space

54. Wall type
1. Open frame
2. Open frame attic knee wall
3. Closed frame
4. Block/masonry
5. Block/masonry in heated basement below grade
6. Closed frame below grade

55. Net wall area in square feet

56. R-value existing

57. R-value to be added

WALL GROUP

#1	#2	#3	#4	
				Type
				Area
				Existing R
				Add R

le has ten groups

ING

58. Color of roof
1. Light
2. Medium
3. Dark

PACIFIC POWER & LIGHT

61 | 61. Is vapor barrier present in the attic?
1. Yes
2. No

62 | 62. Number of ceiling area groups separating living space from unconditioned space

63. Net ceiling area in square feet

64. Existing R-value

65. R-value to be added

CEILING GROUP

	#1	#2	#3	
63				Area
64				Existing R
65				Add R

This table has ten groups

FLOORS

66 | 66. Number of floor area groups separating living space from unconditioned space

67. Floor construction
1. Over vented crawl space
2. Over vented crawl space with automatic ven closures or unheated basement
3. Slab on grade
4. Slab in heated basement
5. Mobile home with skirting - floor to be insulated
6. Mobile home without skirting - floor to be insulated
7. Stem wall/foundation wall

68. Floor area in square feet (items 1, 2, 4, 5 & 6); perimeter in linear feet (item 3) or stem wall/foundation wall area in square feet (item 7)

69. R-value existing

70. R-value to be added

FLOOR GROUP

	#1	#2	#3	
67				Type
68				Area
69				Existing R
70				Add R

This table has ten groups

71 | 71. Square feet of ground cover to be installed

INFILTRATION

72 | 72. House construction
1. Energy saver home standard
2. Good
3. Average
4. Fair
5. Poor

73 | 73. Volume of home's conditioned space in cubic fe

74 | 74. Perimeter of mobile home in linear feet

Form 9254 A (Ed. 10-79) Sheet 1 of 2

Budget Bureau Approval No. 74R0094
Expiration Date July 1982

TVA

District ________

HOME INSULATION PROGRAM
HOME ENERGY SURVEY

Form No. ________

CN 1 Action ________

Name ________ Date ________ Month | Day | Year

Address ________ Phone ________

1 ____ Distributor ________ Account No. ________

2 ____ Type of Customer
(1) Customer Homeowner (2) Customer Tenant
(3) Customer Landlord (4) Noncustomer Landlord

3 ____ Type Home
(1) One story (2) Two story (3) Split-level
(4) Mobile home (5) Other ________

4 ____ Primary Energy Used for Heating
(1) Electric (2) Gas (3) Oil
(4) Other

5 ____ Type of Heating System
(1) Heat Pump (2) Central furnace
(3) Floor Furnace (4) Room heaters

6 ____ Type of Cooling System
(1) Electric central (2) Electric window
(3) Other (4) None

7 ____ Approx. age of residence (years)

EXISTING ATTIC INSULATION

	Area 1	Area 2	Area 3	
8				Heated Area (Sq. Ft.)
9				Existing R-Value
10				Depth (in.)
11				Type* (See below)

ADDITIONAL ATTIC INSULATION RECOMMENDED

	Area 1	Area 2	Area 3	
12				R-Value to be Added
13				Cost/Sq. Ft.
14				Estimated Cost

*(1) Fiberglass Batts (2) Fiberglass loose-fill
(3) Rockwool Batts (4) Rockwool loose-fill
(5) Cellulose (6) Other ________

Comments: ________

ATTIC VENTILATION

	Area 1	Area 2	Area 3	
15				Existing Sq. Ft. Net Free Area
16				To be Added Sq. F Net Free Area
17				Estimated Cost

Comments: ________

AIR INFILTRATION

18		Doors Requiring Weatherstripping
19		Doors Requiring Caulking
20		No. of Thresholds Needed
21		Estimated Cost
22		Windows Requiring Weatherstripping
23		Windows Requiring Caulking
24		Estimated Cost

Comments: ________

25		Duct System Needs Repair (1) Yes (2) No
26		Estimated Cost

Comments: ________

Heat Loss by Infiltration

On pages 4-9, calculate the heat loss by infiltration and by conduction through the separate parts of the building; enter the results in the table at the bottom of each page and in the summary table on page 10.

House Draft Index: Opposite each of the four component parts of a building in the table below, place a check mark in the circle adjacent to the features which best describe the condition of the building.

Building Component	One Air change per hour ①	Two Air change per hour ②	Three Air change per hour ③
Cellar or Crawl Space	Tight, no cracks, caulked sills, sealed cellar windows, no grade entrance leaks Plywood floor, no trap door leaks, no leaks around water, sewer, and electrical openings ○	Some foundation cracks, loose cellar windows, grade entrance not tight Tongue-and-groove board floor, reasonable fit on trap doors, around pipes ○	Major foundation cracks, poor seal around grade entrance Board floor, loose fit around pipes ○
Windows	Storm windows with good fit ○	No storm windows, good fit on regular windows ○	No storm windows, loose fit on regular windows ○
Doors	Good fit on storm doors ○	Loose storm doors, poor fit on inside door ○	No storm doors, loose fit on inside door ○
Walls	Caulked windows and doors, building paper used under siding ○	Caulking in poor repair, building needs paint ○	No indication of building paper, evident cracks around door and window frame ○

FILL IN
AT JOB SITE

Multiply the number of check marks in the first column by 1, the second column by 2, and the third column by 3. The Draft Index will be the sum of these products, divided by 4.

☐	x	☐	=	☐
Floor area sq.ft.		Height to ceiling (to upstairs ceiling in two-story house) ft.		Volume of air in building cu.ft.

☐	x	☐	x	☐	x.02	=	■
Volume of air in building		Draft index		District heating factor			Heating units required

Potential Savings by Reducing Infiltration

It should be possible to reduce the draft index for a building to 1 (that is, reduce the number of air changes to one per hour). If the draft index for this building were improved to 1, the infiltration loss would be:

☐	x	1	x	☐	x.02	=	☐
Volume (from above)		Draft index		District heating factor			Potential heating units

Subtract the potential heating units from those now required and enter here →

Type of Heat Loss	Heating Units Required	Potential Heating Savings	Proposed Changes to Structure	Heating Units to be Saved
Infiltration	■			

INFILTRATION

8.

Floor Area E ______

Terrain Factor R/S ______

BUILDING COMPONENT	GOOD	AVERAGE	POOR
WALLS AND ELECTRICAL OUTLETS	☐ CEILING AND FLOOR JOINTS AND CORNERS WELL SEALED ELECTRICAL OUTLETS WITH GASKETS NO HOLES AROUND PLUMBING PENETRATIONS	☐ SOME CRACKS IN CEILING AND FLOOR JOINTS AND CORNERS NO GASKETS ON ELECTRICAL OUTLETS LESS THAN THREE PLUMBING PENETRATIONS WITH HOLES AROUND THEM	☐ MANY CRACKS IN CEILING AND FLOOR JOINTS AND CORNERS NO GASKETS ON ELECTRICAL OUTLETS THREE OR MORE PLUMBING PENETRATIONS WITH HOLES AROUND THEM
ATTIC FLOOR (CEILING)	☐ NO CRACKS IN ATTIC FLOOR NO AIR SHAFTS AROUND FLUES NO HOLES AROUND DUCTS PIPES OR WIRING PENETRATING ATTIC FLOOR NO RECESSED LIGHT FIXTURES NO TRAP DOOR OR WEATHERSTRIPPED TRAP DOOR TO ATTIC	☐ SOME CRACKS IN ATTIC FLOOR NO AIR SHAFTS AROUND FLUES SOME HOLES AROUND DUCTS PIPES OR WIRING PENETRATING ATTIC FLOOR. LESS THAN THREE RECESSED LIGHT FIXTURES. UNWEATHERSTRIPPED TRAP DOOR TO ATTIC.	☐ MANY CRACKS IN ATTIC FLOOR AIR SHAFTS AROUND FLUES HOLE AROUND DUCTS PIPES OR WIRING PENETRATING ATTIC FLOOR MORE THAN THREE RECESSED LIGHT FIXTURES UNCOVERED ATTIC ACCESS
HEATING SYSTEM & WATER HEATER	☐ BOTH FURNACE AND WATER HEATER ELECTRIC IF FOSSIL FUEL FIRED BOTH IN UNCONDITIONED SPACE	☐ ONE FOSSIL FUEL-FIRED UNIT IN LIVING SPACE WITH VENT DAMPER THE OTHER IN UNCONDITIONED SPACE.	☐ AT LEAST ONE FOSSIL FUEL FIRED UNIT IN LIVING SPACE WITHOUT VENT DAMPER
FIREPLACE OR WOOD STOVE	☐ SEALED COMBUSTION WOOD STOVE OR FIREPLACE WITH WELL FITTING DAMPER AND GLASS DOORS OR NO FIREPLACE	☐ POORLY SEALED WOOD STOVE OR FIREPLACE WITH EITHER WELL FITTING DAMPER OR GLASS DOORS	☐ BOTH A WOOD STOVE AND FIREPLACE OR A FIREPLACE WITH POORLY FITTING DAMPER AND NO GLASS DOORS
DUCTWORK AND FLOOR	☐ NO DUCTWORK AND FEW FLOOR PENETRATIONS OR ALL DUCTWORK IN CONDITIONED SPACE AND NO FLOOR PENETRATIONS	☐ DUCTWORK IN CONDITIONED BASEMENT AND FEW FLOOR PENETRATIONS.	☐ DUCTWORK IN UNCONDITIONED SPACE AND MANY FLOOR PENETRATIONS
VENTS IN CONDITIONED SPACE	☐ NO UNDAMPERED VENTS AND LESS THAN THREE DAMPERED VENTS.	☐ LESS THAN THREE UNDAMPERED VENTS OR AT LEAST THREE DAMPERED VENTS	☐ MORE THAN THREE UNDAMPERED VENTS
LIFESTYLE	☐ LESS THAN SIX ENTRANCES AND EXITS PER DAY	☐ SIX-TO THIRTEEN ENTRANCES AND EXITS PER DAY	☐ MORE THAN THIRTEEN ENTRANCES AND EXITS PER DAY
TOTALS	× 1) +	× 2) +	× 3) = R/S ______

Caulking

Linear Footage =
Square Footage × 1.4

Linear Footage - Cracks R/S ______

Self-Installed Cost R/S ______

Contractor Cost R/S ______

Weatherstripping

Linear Footage =
Square Footage × .87

Linear Footage R/S ______

Self-Installed Cost R/S ______

Contractor Cost R/S ______

where: U_c is the U-value of the ceiling $[W/K/m^2]$;
U_r is the U-value of the roof $[W/K/m^2]$;
ρc is the volumetric specific heat capacity of air $[Wh/m^3/K]$;
V is the ventilation rate per unit area $[m^3/h/m^2]$;
α is the pitch of the roof [%].

For cathedral ceilings this becomes

$$U_{r/c} = \left[\frac{1}{U_c \; 1 + (\alpha/100)^2} + \left[U_r \sqrt{1 + (\alpha/100)^2} + \rho c V \right]^{-1} \right]^{-1} \qquad (9.2)$$

AIR INFILTRATION

Review of the Air Infiltration Model

To compute air infiltration we use the model developed by Sherman and Grimsrud[8].

In the following paragraphs we summarize the derivation of the model equations.

The infiltration for each month is calculated as a superposition of stack and wind effects. The leakage model used assumes the flow to be dominated by inertial effects (turbulent flow), implying that an area can be defined to characterize the leakage:

$$Q = L\sqrt{\frac{2}{\rho \; \Delta P}} \qquad (10)$$

where: Q is the air flow rate through the house envelope (m^3/hr);
ρ is the density of air $[kg/m^3]$;
ΔP is the average pressure difference across the house envelope (Pa).

The problem is thus to calculate ΔP for each house in each terrain and weather. This is done by separating the average infiltration into its stack- driven and wind-driven components.

i) Stack effect

The change in pressure with respect to height is proportional to the air density:

$$\frac{dP}{dh} = -\rho g \qquad (11)$$

thus

$$\frac{d\Delta P}{dh} = -\rho g\left(1 - \frac{\rho'}{\rho}\right) \quad \text{for} \quad \Delta P = P - P' \qquad (12)$$

where: h is height above ground (m);
P is the outside pressure (Pa);
P′ is the inside pressure (Pa).

Using the ideal gas law,

$$\frac{d\Delta P}{dh} = -\rho g \frac{\Delta T}{T} \qquad (13)$$

where: T, ΔT refer to the outside temperature and the inside–outside temperature difference respectively (K).

Integration gives

$$\Delta P - \Delta P_o = -\rho g h \frac{\Delta T}{T} \qquad (14)$$

The constant of integration ΔP_o is fixed by the condition that the volume of air entering the structure equals the volume of air leaving it. So rewriting

$$\Delta P = P_s(\beta_o - \beta) \qquad (15)$$

where: P_s is the stack pressure = $\rho g h \Delta T/T$ (Pa);
H is the height of the house (m);
β is h/H, the dimensionless height;
β_o is the neutral level = $\Delta P_o/P_s$.

To find the infiltration, the differential pressure ΔP, must be integratedover the entire building, keeping track of infiltration and exfiltration separately. We are assuming that the floor and ceiling are each at a single height and that their leakage can be considered uniform, thus eliminating the need for integration to calculate the flow through these surfaces. Rewriting the expressions by using the definition that the floor is at $\beta=0$ and, therefore, the ceiling is at $\beta=1$, we get:

$$Q_C^- = L_C \sqrt{\frac{2}{\rho} P_s \left(\beta^o - 1 \right)} \qquad (16.1)$$

$$Q_F^+ = L_F \sqrt{\frac{2}{\rho} P_s \left(\beta^o \right)} \qquad (16.2)$$

$$Q_C^+ = Q_F^- = 0 \qquad (16.3)$$

where: L_C is the leakage area of the ceiling (m^2);
L_F is the leakage area of the floor (m^2).

The superscripts +/- imply infiltration/exfiltration, respectively.

In stack-dominated flow there is no infiltration through the ceiling nor is there any exfiltration through the floor because of the sign of the pressure difference across them. We can find the infiltration through the walls by integrating from the floor to the neutral level, and the exfiltration by integrating from the neutral level to the ceiling:

$$Q_W^+ = L_W \sqrt{\frac{2}{\rho} P_s} \int_0^{\beta^o} \sqrt{\beta^o - \beta}\; d\beta \qquad (17.1)$$

$$Q_W^- = L_W \sqrt{\frac{2}{\rho} P_s} \int_{\beta^o}^{1} \sqrt{\beta - \beta^o}\; d\beta \qquad (17.2)$$

where: L_W is the leakage area of the walls (m^2).

If we now make the useful definitions,

$$L = L_W + L_C + L_F \qquad (18.1)$$

$$R_L = \frac{L_C + L_F}{L} \qquad (18.2)$$

$$X_L = \frac{L_C - L_F}{L} \qquad (18.3)$$

where: L is the total leakage area (m^2);
R_L is the fraction of leakage in the floor and ceiling;
X_L is the leakage distribution parameter.

We can rewrite the expressions for the total stack infiltration and exfiltration:

$$Q_{stack}^+ = L \sqrt{2gh\frac{\Delta T}{T}} \left[\frac{R_L - X_L}{2} \sqrt{\beta^o} + \frac{2}{3} (1 - R) (\beta^o)^{3/2} \right] \qquad (19.1)$$

$$Q_{stack}^- = L \sqrt{2gh\frac{\Delta T}{T}} \left[\frac{R_L + X_L}{2} \sqrt{1 - \beta^o} + \frac{2}{3} (1 - R) (1 - \beta^o)^{3/2} \right] \qquad (19.2)$$

Treating air as an incompressible gas requires that the infiltration and exfiltration be equal. Therefore, the relationship between the neutral level (β^o), the fractional floor and ceiling leakage (R_L) and the vertical leakage distribution parameter (X) is fixed:

$$X_L = \frac{\frac{4}{3}(1-R) \left[(\beta^o)^{3/2} - (1-\beta^o)^{3/2} \right] + R_L \left[\sqrt{\beta^o} - \sqrt{1-\beta^o} \right]}{\sqrt{\beta^o} + \sqrt{1 - \beta^o}} \qquad (20)$$

Using this expression, any one of the parameters from the set (β^o, X_L, R_L) can be found from the other two.

Because the expressions for infiltration and exfiltration are equal, it does not matter what linear combination of them we use to find the actual air flow; for ease of calculation and minimization of errors, we use the average of the two:

$$Q_{stack} = \frac{L}{3} \sqrt{2gh \frac{\Delta T}{T}} \, (R + 2) \, \frac{\sqrt{\beta^o} \sqrt{1-\beta^o}}{\sqrt{\beta^o} + \sqrt{1-\beta^o}} \tag{21}$$

While it is possible to measure the neutral level directly[9] in most cases it will be the leakage distribution parameter (X_L) that will be available. Accordingly, we have used approximation methods to find an expression for the infiltration that contains X_L instead of the neutral level:

$$Q_{stack} = L \, f_s^* \sqrt{gh \frac{\Delta T}{T}} \tag{22}$$

where: f_s^* is the reduced stack parameter;

$$f_s^* = \frac{(1 + R_L/2)}{3} \left(1 - \frac{X^2}{(2 + R)^2} \right)^{3/2} \tag{23}$$

II) Wind Effect

A pressure difference is caused by loss of kinetic energy when wind strikes a fixed object:

$$\frac{dP}{dv} = -\rho v \tag{24}$$

where

P is the static pressure [Pa] and

v is the real free-stream wind speed [m/s].

"Free-stream wind speed" means the wind speed that would exist if the building wasn't there. Care must be taken in determining it in the above expression. There are two factors which complicate the measurement of the free-stream wind speed: terrain and shielding.

Terrain effects result from the fact that the measurement of wind speed may not occur at the same height or in the same general geographic terrain as the infiltration measurements. Conventionally, we define the wind speed, v, to be the free-stream wind speed at the ceiling height of the structure. This convention for defining wind speed necessitates a method for converting wind speed obtained from a weather-tower measurement to a local free-stream wind speed. To do this, we make use of standard wind-engineering formulae[10]

$$v = v_o \, \alpha \left(\frac{H}{10}\right)^{\gamma} \tag{25}$$

where: v is the actual wind speed at height H (m/s)
v_o is the wind speed at standard conditions of 10 m height and terrain class II;
α, γ are constants that depend on terrain class.

α, and γ describe the wind profile as the wind speed decreases down to zero at ground level. The profile varies depending on the "roughness" of the ground, i.e. the terrain class. Their values are given in table 1.

Table 1. Terrain parameters for standard terrain classes

Class	γ	α	Description
I	0.10	1.30	Ocean or other body of water with at least 5 km of unrestricted expanse
II	0.15	1.00	Flat terrain with some isolated obstacles (e.g. buildings or trees well separated from each other
III	0.20	0.85	Rural areas with low buildings, trees, etc.
IV	0.25	0.67	Urban, industrial or forest areas
V	0.35	0.47	Center of large city (e.g., Manhattan)

To calculate the wind speed at one site from measured data at another site, we first use the above formula to calculate the standard wind speed for the measurement site; then the standard wind speed is used to calculate the wind speed at the desired site. Combining these two calculations gives the wind speed at the desired site directly in terms of the wind speed at the measured site.

$$v = v_W \left[\frac{\alpha \left(\frac{H}{10}\right)^{\gamma}}{\alpha_W \left(\frac{H_W}{10}\right)^{\gamma_W}} \right] \tag{26}$$

In these expressions, the quantities with subscript "W" are for the wind measurement site (weather tower). Values for the two parameters dependent on terrain class are shown in Table 1.

The term in the square brackets in the above expression, is a terrain factor that converts wind speed measured at a weather station into local wind speed.

Although we can now calculate the free-stream wind speed near the house, we are not yet able to calculate the wind pressures felt by the structure because we have not taken into account local shielding. Buildings and other obstructions within a few house-heights of the site will tend to slow or otherwise block the local wind from having its full impact on the structure. To account for this phenomenon, we use a set of shielding coefficients* to convert the free-stream wind pressure into that actually felt by the structure.
Thus,

$$\frac{dP}{dv} = -C\rho v \qquad (27)$$

C is a function of the incident wind angle and position of obstructions, so an average over all angles is needed. One could proceed with this calculation in the same manner as for stack effects; however, since this would require a detailed knowledge of the building structure, which we are trying to avoid, we use an empirical fit to wind tunnel data instead:

$$Q_{wind} = L\ v(1 - R_L)^{1/3}\ C' \qquad (28)$$

where C' is the generalized shielding coefficient.

The wind tunnel study[11] considered only the case of the "self-shielded" structure. In any real situation, however, there will be local obstructions in the neighborhood of the building; we, therefore, propose to break the shielding into five classes, where class I is the "self-shielded" case and the remaining classes scale down the value of the shielding coefficients equally. The values of the shielding coefficients are tabulated in table 2.

We are now in a position to define the reduced wind parameter in a manner similar to that used for the reduced stack parameter; i.e.,

$$Q_{wind} = f_w^*\ L\ v_W \qquad (29)$$

---

*The term shielding coefficient is equivalent to the more standard term of exterior pressure coefficient; the only difference lies in the interpretation. We use the term shielding coefficient to mean the ratio of the average exterior wind pressure to the stagnation pressure at the ceiling height.

Table 2. Generalized shielding coefficient vs. local shielding

Shielding Class	C'	Description
I	0.324	No obstructions or local shielding whatsoever.
II	0.285	Light local shielding with few obstructions. Perhaps a few trees or a small shed.
III	0.240	Moderate local shielding, some obstructions within two house heights. A thick hedge or a solid fence, or one neighboring house.
IV	0.185	Heavy shielding, obstructions around most of perimeter. Buildings or trees within 30ft in most directions. Typical suburban shielding.
V	0.102	Very heavy shielding, large obstruction surrounding perimeter within two house heights. Typical downtown shielding.

where

f_w^* is the reduced wind parameter:

$$f_w^* = C' \, (1 - R_L)^{1/3} \left[\frac{\alpha \left(\frac{H}{10}\right)^{\gamma}}{\alpha_W \left(\frac{H_W}{10}\right)^{\gamma_W}} \right] \tag{30}$$

Our model computes air infiltration on the basis of leakage area, leakage distribution, building height, indoor-outdoor temperature difference and wind speed, and terrain and shielding classes. Normally, the leakage area is measured using a blower door, whereby a house is pressurized at several different pressure differences and the low-pressure region of the resulting curve of flow vs. pressure fitted to a turbulent flow equation. The fitting parameter is the leakage area, or

$$L = Q_4 \sqrt{\frac{\rho}{2 \, \Delta P}} \tag{31}$$

where: Q_4 is the air flow measured at a pressure difference of 4 Pa;
L is the leakage area (m^2).

In the absence of actual measurements with a blower door, the total, floor and ceiling leakage areas are calculated using leakage information on all envelope components:

$$L = \sum_{i=0}^{i_{tot}} l_i \; A_i \qquad L_F = \sum_{i_F=0}^{i_{tot}} l_{i_F} \; A_{i_F} \qquad L_C = \sum_{i_C=0}^{i_{tot}} l_{i_C} \; A_{i_C} \tag{32}$$

where: L, L_F, L_C are the total, floor and ceiling leakage areas, respectively;

l_i is the specific leakage area of the i-th envelope component;

i_F, i_C are indices denoting envelope components in the floor and ceiling, respectively.

Specific leakage area, l_i, expresses the amount of leakage associated with the i-th envelope component as leakage area per unit component area, even though the leakage area will not usually be evenly distributed over the component. It assumes that the amount o' leakage is proportional to the size of the component. Then, values of specific leakage area calculated from experiment can be used to estimate the leakage area of components of the same type but different area. Default values for specific leakage areas used by CIRA for individual building components, are based on measurements or, where necessary, on crack length and width assumptions and standerd engineering calculations.

Specific Air Infiltration for Reference Conditions

When part or all of the leakage areas are measured, the calculated leakage areas above are scaled accordingly. Temperature and average wind speed will vary for each month of CIRA's monthly calculations, while the reduced stack and wind parameters won't. Thus stack and wind effects are precalculated for a reference house in reference surroundings and are corrected to reflect actual circumstances and actual temperature difference. The reference house is a single-story dwelling (height=2.5m) with average leakage distribution (R=0.5; i.e., ceiling and floor leakage areas together are equal to the wall leakage area), and for the reference surroundings which are terrain class III (rural areas with low buildings and trees) and shielding class III (some obstructions within two house heights). The total air infiltration is given by

$$Q = L \sqrt{(c_s \; q_s)^2 + (c_w \; q_w)^2} \tag{33}$$

where: q_s, q_w are the monthly specific infiltrations due to stack and wind, respectively [$m^3/hr/cm^2$];

c_s, c_w are factors to correct for the non-standard house in non-standard surroundings.

The correction factors are:

$$c_w = 8.15\ C'\ (1 - R_L)^{1/3}\ \alpha\left(\frac{H}{10}\right)^{\gamma} \qquad (34.1)$$

$$c_s = 1.60\ \left(1 + \frac{R_L}{2}\right)\ \left[1 - \frac{(X_L)^2}{(2 - R_L)^2}\right]^{3/2}\ \sqrt{\frac{H}{10}} \qquad (34.2)$$

where:

$$R_L = \frac{L_C + L_F}{L} \qquad X_L = \frac{L_C - L_F}{L} \qquad H = \text{househeight}\,[m] \qquad (34.3)$$

and C′ pertains to the shielding class, and α, γ, to the terrain class, respectively as defined above.[8]

The monthly specific infiltrations q_s and q_w ($m^3/hr/cm^2$) for this reference house have been calculated for 59 cities, using weather tapes. Table 3 shows the seasonal values only for these cities.

Table 3: Seasonal specific infiltration ($m^3/hr/cm^2$) in 59 U.S. cities

City	$\frac{Q_{stack}}{L}$	$\frac{Q_{wind}}{L}$	$\frac{Q}{L}$	City	$\frac{Q_{stack}}{L}$	$\frac{Q_{wind}}{L}$	$\frac{Q}{L}$
Albany, NY	.21	.23	.31	Medford OR	.18	.10	.21
Albuquerque	.18	.17	.24	Memphis TN	.15	.21	.26
Amarillo TX	.17	.30	.35	Miami FL	.00	.20	.20
Atlanta GA	.15	.22	.26	Minneapolis	.23	.23	.32
Bismarck ND	.24	.23	.33	Nashville TN	.16	.22	.27
Boise ID	.19	.20	.27	New Orleans	.12	.22	.25
Boston MA	.19	.32	.37	New York NY	.17	.27	.32
Brownsville	.05	.26	.27	Norfolk VA	.15	.26	.31
Buffalo NY	.20	.29	.35	Oklahoma Ci.	.17	.32	.36
Burlington	.21	.22	.31	Omaha NE	.20	.23	.31
Charleston	.13	.21	.25	Philadelphia	.18	.26	.32
Cheyenne WY	.20	.29	.35	Phoenix AX	.12	.10	.16
Chicago IL	.19	.22	.29	Pittsburgh	.19	.19	.27
Cincinnati	.18	.20	.27	Raleigh NC	.16	.21	.26
Cleveland OH	.20	.25	.32	Richmond VA	.18	.19	.26
Columbia MO	.18	.22	.29	Sacramento	.16	.14	.21
Detroit MI	.20	.26	.33	Salt Lake C.	.20	.18	.27
Dodge City	.19	.29	.35	San Antonio	.12	.21	.25
El Paso TX	.15	.19	.24	San Diego CA	.11	.15	.19
Fort Worth	.14	.25	.29	S. Francisco	.14	.19	.24
Fresno CA	.14	.12	.19	Seattle WA	.17	.22	.28
Great Falls	.21	.36	.42	St. Louis MO	.19	.24	.30
Houston TX	.12	.25	.27	Tampa FL	.06	.21	.21
Indianapol	.19	.24	.31	Tulsa OK	.16	.24	.29
Kansas City	.19	.23	.30	Washing. DC	.17	.17	.24
Lake Charles	.12	.21	.24	Jacksonville	.10	.20	.23
Los Angeles	.11	.17	.20	Jackson MS	.14	.22	.26
Louisville	.18	.23	.29	Portland ME	.21	.19	.28
Lubbock TX	.16	.30	.34	Portland OR	.17	.23	.29
Madison WI	.21	.21	.30				

RADIATIVE HEAT EXCHANGES

Solar gains

The solar gains for 5 orientations (including horizontal) are computed as a product of a solar aperture, a solar exposure modifier and the solar flux for that orientation. The total solar gain for the house is computed for each month as the sum of the above five solar gains.

$$S = \sum_{v=1}^{5} \sigma_v \psi_v \theta_v \left(I_v + \frac{\rho_g}{2} I_5 \right) \qquad (35)$$

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BUILDING PRACTICE NOTE

ESTIMATING ENERGY SAVINGS FROM REINSULATING HOUSES

by

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Division of Building Research, National Research Council of Canada

Ottawa, May 1981

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Burlington	.21	.22	.31	Omaha NE	.20	.23	.31
Charleston	.13	.21	.25	Philadelphia	.18	.26	.32
Cheyenne WY	.20	.29	.35	Phoenix AX	.12	.10	.16
Chicago IL	.19	.22	.29	Pittsburgh	.19	.19	.27
Cincinnati	.18	.20	.27	Raleigh NC	.16	.21	.26
Cleveland OH	.20	.25	.32	Richmond VA	.18	.19	.26
Columbia MO	.18	.22	.29	Sacramento	.16	.14	.21
Detroit MI	.20	.26	.33	Salt Lake C.	.20	.18	.27
Dodge City	.19	.29	.35	San Antonio	.12	.21	.25
El Paso TX	.15	.19	.24	San Diego CA	.11	.15	.19
Fort Worth	.14	.25	.29	S. Francisco	.14	.19	.24
Fresno CA	.14	.12	.19	Seattle WA	.17	.22	.28
Great Falls	.21	.36	.42	St. Louis MO	.19	.24	.30
Houston TX	.12	.25	.27	Tampa FL	.06	.21	.21
Indianapol	.19	.24	.31	Tulsa OK	.16	.24	.29
Kansas City	.19	.23	.30	Washing. DC	.17	.17	.24
Lake Charles	.12	.21	.24	Jacksonville	.10	.20	.23
Los Angeles	.11	.17	.20	Jackson MS	.14	.22	.26
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Preface

This paper presents a method for estimating energy savings from reinsulating houses. The method uses the previous year's fuel bill and is aimed at existing houses; it is not intended for use in the design of new houses. As further information becomes available, some of the factors and tables may be revised. The Division of Building Research welcomes comments.

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ESTIMATING ENERGY SAVINGS FROM REINSULATING HOUSES

by

R.L. Quirouette and E.C. Scheuneman

INTRODUCTION

This Note presents a method of estimating the savings from adding more insulation (reinsulating) to an existing house as well as a means for determining the payback period of particular retrofit measures. It is a development of the methodology originated by R.L. Quirouette for the Division of Building Research 1978 Seminar/ Workshop - Insulating Existing Houses.

The most common way to estimate energy savings due to reinsulation is termed the "degree-day (DD) method." It uses a single coefficient to account for the effect of occupancy-generated heat gains, solar heat gains through windows, and thermal storage effect. Because the combined effects of these conditions can vary so widely even in identical houses, the prediction of energy consumption can and does vary widely from actual fuel records. Hence, savings predicted by this method are subject to important uncertainties.

The energy saved by reinsulating a particular house can be determined with greater confidence by using the previous year's fuel bill and an estimate of the "actual degree-days (ADD)" to calculate a range of energy savings by identifying the minimum and maximum values that may be obtained from particular retrofit measures. Since the actual savings will lie between the minimum and maximum limits, a further calculation termed "probable savings" is introduced to facilitate the economic analysis that follows.

The application of this method is explained in detail in this Note; the theory is left for another paper to be published as a DBR Building Research Note. A companion publication to this paper will provide the user with a computer program for hand-held computers.

EQUATIONS FOR DETERMINING MINIMUM (S_1) AND MAXIMUM (S_2) SAVINGS

The minimum and maximum savings are firm theoretical limits although the accuracy of the predictions depends on the accuracy of the information obtained. The following formulae apply to both metric SI and imperial units except as noted for maximum savings, S_2.

The following equation is used to calculate S_1, the minimum savings.

$$S_1 = F_B \times \frac{(Q_1 - Q_2)}{\text{Total } Q_1} \qquad (1)$$

where S_1 = minimum savings in dollars per heating season for each upgraded building component

F_B = the previous year's fuel bill for space heating

Q_1 = original heat flow through each building component

Q_2 = new heat flow through each building component being upgraded

Total Q_1 = the sum of all the Q_1's

The following equation is used to calculate S_2, the maximum savings.

$$S_2 = 86{,}400 \times \text{ADD} \times \frac{K_1}{K_2 \times K_3} \times (Q_1 - Q_2) \quad \text{(metric SI units)} \qquad (2)$$

or

$$S_2 = 24 \times \text{ADD} \times \frac{K_1}{K_2 \times K_3} \times (Q_1 - Q_2) \quad \text{(imperial units)} \qquad (3)$$

where S_2 = maximum savings in dollars per heating season

86,400 = number of seconds in a day to correspond to Joule/second

24 = number of hours in a day to correspond to Btu/hour

ADD = actual degree-days

K_1 = cost of fuel per unit at same price as used for fuel bill, F_B

K_2 = heat content of fuel per unit

K_3 = seasonal efficiency of heating plant

Q_1 = original heat flow through each building component

Q_2 = new heat flow through each building component being upgraded

EQUATIONS FOR DETERMINING PROBABLE SAVINGS (S_p)

For those users wanting an estimate of probable savings a further calculation is provided which is subject to two conditional equations. These equations estimate where the savings lie between the minimum and maximum limits. This technique is a new theoretical treatment and, therefore, may be subject to modification after further experience.

(a) Total $S_2 \leq F_B$

When the total of the maximum savings (S_2's) is less than or equal to the previous year's fuel bill (F_B), use

$$S_p = S_1 + 0.75\ (S_2 - S_1) \tag{4}$$

to calculate the component probable savings (S_p's).

(b) Total $S_2 > F_B$

When the Total of the S_2's is greater than F_B, there are two ways to proceed:

(i) If all the retrofit options from this Total S_2 package are going to be done, use the formula

$$\text{Total } S_p = \text{Total } S_1 + 0.75\ (F_B - \text{Total } S_1) \tag{5}$$

and do not calculate the component S_p's which are not required since it is the savings of the entire retrofit package that is of interest.

(ii) If only certain retrofit options from this Total S_2 package are going to be done, calculate the new lower Total S_2 for these options and compare the Total S_2 to F_B.

If Total $S_2 \leq F_B$, use procedure (a) above.
If Total $S_2 > F_B$, use procedure (b) (i) above.

Note: The condition of section (b), Total $S_2 > F_B$, will not occur often. However, it could happen when making major retrofits on buildings that have a high proportion of internal and free heat gains relative to their total heat loss. Highly insulated and passive-solar heated buildings could fall into this category. Further explanations will be given in the theoretical paper.

ENERGY SAVINGS CHART

The chart on the following two pages (charts 1A and 1B) has been developed to facilitate the presentation of the house characteristics and the analysis of the data and results for use in energy audit work. One is for metric SI units and the other for imperial units. The different parts of the S_1 and S_2 equations and this chart are discussed in general terms before an example calculation and analysis is carried out for a particular house. The calculations in this paper use metric SI units. For calculations in imperial units conversion tables are given in Appendix A.

F_B (Fuel Bill for Space Heating)

This cost should be determined from the previous year's fuel bills over a 12-month period, usually spring-to-spring or fall-to-fall. In cases where the same fuel is used for space heating and other uses such as appliances and water heating, it will be necessary to separate out the non-space heating costs. This is done by taking the average of the monthly fuel bills during the non-heating months (usually June through September), multiplying by 12, and subtracting this amount from the total twelve-month fuel bill.

Q's (Heat Flows)

This is the amount of heat per unit of time per degree of temperature difference that flows through a building component. It is defined and calculated by the equation

$$Q = \frac{A}{R}$$

where A = area of the component
R = thermal resistance of the component

Both of these quantities, A and R, must be measured and/or calculated first before Q can be calculated.

The heat flow (loss) due to air change is calculated by using the formula

$Q = 0.361 \times AC/h \times Vol$ ($Q = 0.0183 \times AC/h \times Vol$ for imperial units)

where AC/h (air change per hour) is explained in a following section; Vol is the volume of heated space in the house.

(i) A (area of component)

Areas are measured and calculated from the external house dimensions. Window and door opening areas are determined from the gross openings (the component plus its frame).

CHART NO. 1A

ENERGY SAVINGS CHART

(metric SI units)

NAME ____________________

ADDRESS ____________________

CITY ____________ PROV ____________

TYPE OF HOUSE ____________________

VOLUME OF HEATED SPACE ____________________

HEATING SYSTEM ____________________

HOT WATER HEATING ____________________

FUEL BILL, F_B = ____________________

K_1 = ____________________

INTERIOR TEMP. (T_i) ____________________

DEGREE-DAYS (DD) ____________________

AIR CHANGE/h (No.) ____________________

K_2 = ____________________

K_3 = ____________________

		PREVIOUS YEAR			RETROFIT						
NO.	BUILDING COMPONENT	A	R_1	$Q_1 = \frac{A}{R_1}$	R_2	$Q_2 = \frac{A}{R_2}$	S_1	S_2	S_p	C	C/S
1											
2											
3											
4											
5											
6											
7											
8											
9											
10											
11	AIR CHANGE, Q = 0.361 x Vol. x No.		No.		No.						
12	TOTAL										

$$S_1 = F_B \times \frac{(Q_1 - Q_2)}{\text{TOTAL } Q_1}$$

ADD = DD + (T_i − 18) × b = ____________________

$$S_2 = 86,400 \times \text{ADD} \times \frac{K_1}{K_2 \times K_3} \times (Q_1 - Q_2)$$

$$= \_\_\_ \times (Q_1 - Q\ )$$

(a) $$\frac{\text{TOTAL } S_2 \leq F_B}{S_p = S_1 + 0.75\ (S_2 - S_1)}$$

(b) $$\frac{\text{TOTAL } S_2 > F_B}{\text{TOTAL } S_p = \text{TOTAL } S_1 + 0.75\ (F_B - \text{TOTAL } S_1)}$$

CHART NO. 1B

ENERGY SAVINGS CHART

(imperial units)

NAME ______________________

ADDRESS ______________________

CITY ____________ PROV ____________

TYPE OF HOUSE ______________

VOLUME OF HEATED SPACE ______________

HEATING SYSTEM ______________

HOT WATER HEATING ______________

FUEL BILL, F_B = ______________

K_1 = ______________

INTERIOR TEMP. (T_i) ______________

DEGREE-DAYS (DD) ______________

AIR CHANGE, h (No.) ______________

K_2 = ______________

K_3 = ______________

		PREVIOUS YEAR			RETROFIT						
NO.	BUILDING COMPONENT	A	R_1	$Q_1 = \frac{A}{R_1}$	R_2	$Q_2 = \frac{A}{R_2}$	S_1	S_2	S_p	C	C/S
1											
2											
3											
4											
5											
6											
7											
8											
9											
10											
11	AIR CHANGE, Q=0.0183 x Vol. x No.		No.		No.						
12	TOTAL										

$$S_1 = F_B \times \frac{(Q_1 - Q_2)}{\text{TOTAL } Q_1}$$

ADD = DD + (T_i - 65) x b = ______________

$$S_2 = 24 \times \text{ADD} \times \frac{K_1}{K_2 \times K_3} \times (Q_1 - Q_2)$$

$$= \_\_\_\_\_\_ \times (Q_1 - Q_2)$$

(a) $\frac{\text{TOTAL } S_2 \leq F_B}{S_p = S_1 + 0.75\ (S_2 - S_1)}$

(b) $\frac{\text{TOTAL } S_2 > F_B}{\text{TOTAL } S_p = \text{TOTAL } S_1 + 0.75\ (F_B - \text{TOTAL } S_1)}$

(ii) R-values (Thermal Resistances)

To determine nominal R-values for building components such as walls, ceilings and windows, the individual R-values of the materials making up the building component (including the appropriate R-values for an interior and exterior air film) are added up. A list of thermal resistances, R-values, for building materials and air films/spaces is given in Table B-1 (Appendix B).

Below-grade construction such as basements require special treatment. This is explained in Appendix B with Table B-2 providing R-values for typical constructions.

For improved accuracy of R-value calculations, the "thermal bridging effect" described in Appendix C should be taken into account.

ADD (Actual Degree-Days)

This method uses ADD (actual degree-days) to calculate savings. ADD is a measure of the actual temperature difference between the interior house temperature (T_i) and the outdoor temperature. This is different from standard DD (degree-days) which are computed from a base interior temperature of 18°C (65°F). The concept and calculation of ADD are given in Appendix D.

Heating System Factors

The determination of maximum savings, S_2, requires certain heating system factors. These factors which characterize the performance of the heating system are the cost of fuel (K_1), the heat content of fuel (K_2), and the seasonal efficiency (K_3).

(i) K_1 (Cost per Unit of Fuel)

This constant is the price in dollars per unit of fuel used. The price used should be the same as that used for the fuel bill. The normal units would be as follows:

Fuel oil (domestic)	\$/litre	(\$/gal)
Natural gas	$\$/m^3$	$(\$/ft^3)$
Electricity	\$/kW·h	(\$/kW·h)

(ii) K_2 (Heat Content per Unit of Fuel)

These values of the heat content for different fuels are given in Table 1. It should be noted that the same fuel unit must be used for both K_1 and K_2. For example, if \$/litre is used in K_1, then J/litre must be used for K_2.

TABLE 1. HEATING VALUE OF SOME COMMON HEATING FUELS

Fuel	SI (Joule)	Imperial (Btu)
Fuel oil (domestic)	38 757 000 per litre	167 000 per gal
Natural gas	37 300 000 per m^3	1 000 per ft^3
Electricity	3 600 000 per kW·h	3 413 per kW·h

(iii) K_3 (Seasonal Efficiency of Heating System)

This is the factor that determines the useful heat delivered to the house from the potential amount of heat in the fuel used during the heating season. A further explanation will be found in Appendix E.

Air Change Rate (air change/hour, AC/h)

Estimating the air leakage rate is a complicated task that involves an analysis of the effect of wind conditions and the stack effect pressures on the leakage openings of a house. Even then the results of this analysis are often too simplistic since the actual air leakage patterns and rates are altered by operational characteristics such as the opening and closing of windows and doors, and the operation of fireplaces, fuel-burning appliances, and exhaust fans.

It is generally accepted that there is a relationship between the indoor relative humidity during the heating season and the air leakage rate of a small house if it is occupied and no mechanical humidification is used. If the information in the paragraph that follows is not available, the value 1.00 air change/hour may be used as a "default" or "best guess" value.

The January and February indoor relative humidity (R.H.) can be approximately correlated to air change rates as follows:

- 15 to 25% R.H. as measured or indicated by dryness in the occupant's nose and throat or "shocks" from static electricity would suggest an air change rate of 1.50/h or higher.

- 25 to 35% R.H. as measured or indicated by slight condensation on double-glazed windows would suggest an air change rate of 0.75/h.

- 35% and higher R.H. as measured or indicated by frost on windows for long periods and mildew/fungus growth on organic materials would suggest an air change rate of 0.25/h or less. (This may occur in some electrically-heated homes because the absence of chimneys makes them generally tighter than houses with fuel-fired heating systems.)

Since there is uncertainty in estimating an air change rate, it may be preferable to estimate a high and low rate to give a range of values. This range is calculated by adding to and subtracting 50% from the value selected above. This provides a reasonable margin of error and can be used to illustrate the influence of air change rates on the predicted savings.

Applying the high/low range to these values would yield the following:

- 1.00/h transforms to 1.50 and 0.50
- 1.50/h transforms to 2.25 and 0.75
- 0.75/h transforms to 1.13 and 0.38
- 0.25/h transforms to 0.38 and 0.13

Cost and Payback

The cost for each retrofit action may vary considerably depending on who is doing the work (homeowner or contractor). Also, some material costs may be significantly reduced by government grant programs.

This simplified payback calculation,

$$\text{Payback} = \frac{\text{Costs}}{\text{Savings}} = \frac{C}{S}\ \text{(years)}$$

assumes that the fuel price escalation is approximately the same as the interest rate on savings. Any significant cost reductions, as in the preceding paragraph, would provide shorter payback periods.

EXAMPLE 1. - BASIC DATA CALCULATIONS AND #1 RETROFIT

Location:	Ottawa
Type of House:	two-storey, detached
Volume of Heated Space:	481.4 m^3
Heating System:	oil-fired, forced warm air
Hot Water Heating:	electric
Fuel Bill, F_B =	\$1239 (for 5682 litre)
Cost per Unit of Fuel, K_1 =	\$0.218/litre

Step 1 - Basic House Data

- The basic data from above is entered on to the top of chart 2 (next page).

Step 2 - Climate and Air Change

- The climate and air change section at the top of chart 2 is filled in as follows:

- T_i is 21°C.
- DD for Ottawa is 4674
- Air change/hour was chosen to be the default value of 1.00/h since we had no further information
- K_2 for oil from Table 1 is 38 757 000
- K_3 is chosen to be the default value of 0.55 (from Appendix E)

CHART NO. 2

ENERGY SAVINGS CHART

(metric SI units)

NAME
ADDRESS
CITY OTTAWA PROV ONT.

TYPE OF HOUSE 2-storey detached
VOLUME OF HEATED SPACE 481.4 m^3
HEATING SYSTEM oil-fired forced air
HOT WATER HEATING electric
FUEL BILL, F_B = $1239
K_1 = $ 0.218/litre

INTERIOR TEMP. (T_i) 21°C
DEGREE-DAYS (DD) 4674
AIR CHANGE/h (No.) 1.00
K_2 = 38,757,000
K_3 = 0.55

		PREVIOUS YEAR			#1 RETROFIT						
NO.	BUILDING COMPONENT	A	R_1	$Q_1 = \frac{A}{R_1}$	R_2	$Q_2 = \frac{A}{R_2}$	S_1	S_2	S_p	C	C/S
1	Ceiling	65.0	2.11	31	5.64	12	46	87	77	280	3.6
2	Frame walls	143.1	1.76	81	2.29	62	46	87	77	1100	14.3
3	Header joists	14.8	0.60	25							
4	Basement walls, A.G.	19.5	0.26	75	2.47	8	163	305	270	900	2.0
5	Basement walls, B.G.	49.2	0.8	62	3.2	15	115	214	189		
6	Basement floor	65.0	4.6	14							
7	Windows	13.9	0.35	40							
8	Doors	3.7	0.70	5							
9											
10											
11	AIR CHANGE, Q = 0.361 x Vol. x No.		No. 1.00	174	No.						
12	TOTAL			507			370	693	613	2280	3.7

$$S_1 = F_B \times \frac{(Q_1 - Q_2)}{\text{TOTAL } Q_1}$$

$$ADD = DD + (T_i - 18) \times b = \underline{4674 + (21-18) \times 161 = 5157}$$

$$S_2 = 86,400 \times ADD \times \frac{K_1}{K_2 \times K_3} \times (Q_1 - Q_2)$$

$$= \underline{4.557} \times (Q_1 - Q_2)$$

(a) $\dfrac{\text{TOTAL } S_2 \leq F_B}{S_p = S_1 + 0.75\ (S_2 - S_1)}$

(b) $\dfrac{\text{TOTAL } S_2 > F_B}{\text{TOTAL } S_p = \text{TOTAL } S_1 + 0.75\ (F_B - \text{TOTAL } S_1)}$

Step 3 - Building Components and Areas

- List all the building components that make up the building envelope, e.g. ceiling, frame walls, header joists, basement walls above grade (A.G.) and below grade (B.G.), basement floor, windows, exterior doors.

- The area of each component is entered in column A of Chart 2. Note that the areas of the windows and doors should be subtracted from the appropriate gross wall areas to give the net wall areas.

Step 4 - R_1 Values

- Each building component has an R-value. Calculate the R-values of materials from Table B-1 (Appendix B) and then sum these up for the component R-value.

- For the basement walls below grade and basement floor one uses Table B-2 (Appendix B).

- Exterior doors constructed of solid-core wood with a storm door have an R of 0.70.

- R-values are written in the R_1 column of chart 2.
- AC/h (No.) is written in the R_1 column of row 11.

Step 5 - Heat Flow, Q_1

- The Q_1 column of chart 2 is filled by dividing each A by its respective R_1.
- The Q_1 for air change is calculated by using the formula

$$Q_1 = 0.361 \times AC/h \times Vol$$

- Q_1 values are rounded to the nearest unit.
- The total Q_1 is calculated by adding up the individual Q_1's. This result is entered in the Total row of the Q_1 column.

Step 6 - Selection of Retrofit Options

By examining the figures in column Q_1, one notes the relative importance of each building component regarding heat loss (Q_1). The larger the number, the greater the heat loss. In this case, air change contributes the greatest heat loss followed by frame walls, basement walls above grade, basement walls below grade, windows, ceiling, header joists, basement floor, and doors. One usually concentrates on the areas or components of greatest heat loss since these present the greatest potential for overall savings. Sometimes the areas of smaller heat loss will be the easiest and cheapest to retrofit. There are other factors to consider including the physical feasibility of each retrofit action.

As the purpose of this paper is to assist one in estimating the savings and payback for different retrofit options, the following retrofit actions have been evaluated:

Ceiling, from $R_1 = 2.11$ to $R_2 = 5.64$, Cost (C) = \$280
Frame walls, from $R_1 = 1.76$ to $R_2 = 2.29$, Cost (C) = \$1100
Basement walls A.G., from $R_1 = 0.26$ to $R_2 = 2.47$
Basement walls B.G., from $R_1 = 0.8$ to $R_2 = 3.2$ Cost (C) = \$900

Step 7 - R_2 Values and Cost (C)

- The R_2's from Step 6 are the combined R-value of the original R plus the added insulation and are written in the appropriate rows in the R_2 column of chart 2 while leaving the remaining rows blank. This section should be labelled #1 Retrofit to avoid confusion with different calculations that may be done later for the same house.

- The C's from Step 7 are written in the appropriate rows in the C column of the #1 Retrofit section, and added up to give the Total C.

Step 8 - Q_2's

- The Q_2 for each R_2 of chart 2 is calculated by dividing each A by its R_2 and rounding to the nearest unit.

Step 9 - Calculation of Minimum Savings, S_1

- The S_1's are calculated for each upgraded component of chart 2 by using the formula:

$$S_1 = F_B \times \frac{(Q_1 - Q_2)}{\text{Total } Q_1}$$

- The S_1's are added and the result entered in the Total row.

Step 10 - Calculation of Maximum Savings, S_2

- The S_2's are calculated for each upgraded component of chart 2 by using the formula

$$S_2 = 86\ 400 \times \text{ADD} \times \frac{K_1}{K_2 \times K_3} \times (Q_1 - Q_2)$$

We know all the values in the S_2 equation except for ADD. The value for ADD is calculated as

ADD = 4674 + (21 - 18) x 161 = 5157 where b = 161 from Figure D-1 (app. D),

and entered on to chart 2 (bottom left).

- Since $86\ 400 \times \text{ADD} \times \frac{K_1}{K_2 \times K_3}$ remains the same for each particular house if no change occurs to the heating system, it is convenient to calculate this constant once as follows

$$86\ 400 \times 5157 \times \frac{0.218}{38\ 757\ 000 \times 0.55} = 4.557$$

and write it into the blank of the S_2 equation on chart 2 (bottom left).

This simplified form, $S_2 = 4.557 \times (Q_1 - Q_2)$, can be used to calculate all the various S_2's.

- the S_2's are calculated for the upgraded Q_2's.
- the S_2's are added and the result entered in the Total row.

Step 11 - Calculation of Probable Savings, S_p

Since the total S_2 of chart 2 is \$693 which is less than the F_B of \$1239, Total $S_2 < F_B$, the (a) formula is used to calculate the individual S_p's, that is,

$$S_p = S_1 + 0.75\ (S_2 - S_1)$$

- Calculate the S_p's for the appropriate Q_2's.
- Add up the S_p's to get Total S_p.

Step 12 - Calculation of Payback, C/S

Depending on whether the minimum/maximum limits of payback or the probable payback is desired, one can use any or all of S_1, S_2, and S_p to calculate the payback time period(s). For this example of chart 2 we will use S_p.

The paybacks are calculated for each upgrading measure by dividing the upgrading cost (C) by each S_p (C/S_p). Note that there is a combined payback for basement walls above and below grade because the price quotation of \$900 covers the entire basement wall area.

- The total payback is calculated by dividing total C by total S_p.

Step 13 - Calculation of Minimum/Maximum Payback

To further illustrate this method, the minimum and maximum payback is calculated below for each Q_2 (R_2).

	Minimum Payback (C/S_2), years	Maximum Payback (C/S_1), years
Ceiling	$\frac{280}{87} = 3.2$	$\frac{280}{46} = 6.1$
Frame Walls	$\frac{1100}{87} = 12.6$	$\frac{1100}{46} = 23.9$
Basement Walls A.G. & B.G.	$\frac{900}{519} = 1.7$	$\frac{900}{278} = 3.2$
Total	$\frac{2280}{693} = 3.3$	$\frac{2280}{370} = 6.2$

Example 2. - #2 Retrofit

This example illustrates the estimated savings and paybacks resulting from going to higher insulation levels for the following components. Frame walls have been left out because the #1 retrofit filled the remainder (36 mm) of the cavity (100 mm total) and so higher R-values cannot be achieved from the cavity since additional insulation cannot be added.

Ceiling, from $R_1 = 2.11$ to $R_2 = 10.57$, Cost (C) = \$700

Basement Walls A.G., from $R_1 = 0.26$ to $R_2 = 3.70$ Cost (C) = \$1100
Basement Walls B.G., from $R_1 = 0.8$ to $R_2 = 3.9$

Step 1 - R_2's and C's

The R_2's and C's are entered into the appropriate rows and columns in the Retrofit section which is labelled #2 Retrofit. (See chart 3.)

Step 2 - Calculations of Q_2, S_1, S_2, S_p

- The calculations are carried out for Q_2, S_1, S_2, and S_p and the quantities entered in the appropriate boxes in the #2 Retrofit section of chart 3.

Step 3 - Payback, C/S

- The desired savings from S_1, S_2, and S_p are chosen to calculate the payback. For this example we will again choose S_p which gives a payback of 6.9 years for the ceiling, 2.3 years for the basement walls, and 3.1 years total for both. (See chart 3.) These payback periods are reasonably short.

These results can be compared with the #1 Retrofit (chart 2) results to aid in choosing levels of insulation.

CHART NO. 3

ENERGY SAVINGS CHART

(metric SI units)

NAME

ADDRESS

CITY OTTAWA PROV ONT.

TYPE OF HOUSE 2-storey, detached

VOLUME OF HEATED SPACE 481.4 m^3

HEATING SYSTEM oil-fired, forced air

HOT WATER HEATING electric

FUEL BILL, F_B = $1239

K_1 = $ 0.218/litre

INTERIOR TEMP. (T_i) 21°C

DEGREE-DAYS (DD) 4674

AIR CHANGE/h (No.) 1.00

K_2 = 38,757,000

K_3 = 0.55

		PREVIOUS YEAR			#2 RETROFIT						
NO.	BUILDING COMPONENT	A	R_1	$Q_1 = \frac{A}{R_1}$	R_2	$Q_2 = \frac{A}{R_2}$	S_1	S_2	S_p	C	C/S
1	Ceiling	65.0	2.11	31	10.57	6	61	114	101	700	6.9
2	Frame Walls	143.1	1.76	81							
3	Header joists	14.9	0.60	25							
4	Basement walls, A.G.	19.5	0.26	75	3.70	5	171	319	282	1100	2.3
5	Basement walls, B.G.	49.2	0.8	62	3.9	13	120	223	197		
6	Basement floor	65.0	4.6	14							
7	Windows	13.9	0.35	40							
8	Doors	3.7	0.70	5							
9											
10											
11	AIR CHANGE, Q = 0.361 x Vol. x No.		No. 1.00	174	No.						
12	TOTAL			507			352	656	580	1800	3.1

$$S_1 = F_B \times \frac{(Q_1 - Q_2)}{\text{TOTAL } Q_1}$$

$ADD = DD + (T_i - 18) \times b =$ 4674 + (21-18) x 161 = 5157

$$S_2 = 86,400 \times ADD \times \frac{K_1}{K_2 \times K_3} \times (Q_1 - Q_2)$$

$= \underline{4.557} \times (Q_1 - Q_2)$

(a) $\frac{\text{TOTAL } S_2 \leq F_B}{S_p = S_1 + 0.75\,(S_2 - S_1)}$

(b) $\frac{\text{TOTAL } S_2 > F_B}{\text{TOTAL } S_p = \text{TOTAL } S_1 + 0.75\,(F_B - \text{TOTAL } S_1)}$

EXAMPLE 3 - EFFECTS OF HIGH/LOW AIR CHANGE RATES

The same house from Example 1 is used to show the effects of varying the air change rate. The value of 1.00 AC/h used in Example 1 is increased and decreased by 50% to give the high/low range of 1.50 to 0.50. The same basic data and the same #1 Retrofit R_2 from chart 2 values are used to carry out two sets of calculations using the high (chart 4) and low (chart 5) air change rate.

A comparison of the results from charts 4 and 5 shows the following range of savings for the #1 Retrofit actions:

Air change/hour	S_1	S_2	S_p
	(1.50 → 0.50)	(1.50 → 0.50)	(1.50 → 0.50)
Ceiling	\$ 40 → \$ 56	\$ 87 → \$ 87	\$ 75 → \$ 79
Frame walls	\$ 40 → \$ 56	\$ 87 → \$ 87	\$ 75 → \$ 79
Basement walls A.G.	\$140 → \$197	\$305 → \$305	\$264 → \$278
Basement walls B.G.	\$ 98 → \$139	\$214 → 214	\$185 → \$195
Total	\$318 → \$448	\$693 → \$693	\$599 → \$631

These results show that the high/low range of air change/hour produces a 41% range for S_1 values; however it should be noted that it makes no difference to S_2 but does affect the S_p's by 5%. An analysis of the effects on the #2 Retrofit actions of Example 2 from chart 3 would show the same per cent ranges.

EXAMPLE 4 - AIR CHANGE REDUCTION BY RETROFITTING

Often the most cost-effective retrofit action is the tightening up of a house by weatherstripping, caulking, or using other means to reduce air leakage and the air change rate. It is difficult, however, to measure or determine the initial and final air change rates for a house. Hence, the following example is an illustration rather than a guarantee of possible savings.

For a "leaky" house with an air change of 1.50/h it is possible to effect a 50% reduction by thorough, careful tightening of the house.

The same house as in Example 1 (chart 2) will be assumed except that the original (R_1) AC/h is 1.50 and the new (R_2) AC/h is 0.75.

Chart 6 shows the data and calculation giving values of

$$S_1 = \$273$$
$$S_2 = \$597$$
$$S_p = \$516$$

from this retrofit action. This suggests a large savings that should be very cost-effective.

CHART NO. 4

ENERGY SAVINGS CHART

(metric SI units)

NAME ____

ADDRESS ____

CITY OTTAWA PROV ONT.

TYPE OF HOUSE 2-storey, detached

VOLUME OF HEATED SPACE 481.4 m^3

HEATING SYSTEM oil-fired, forced air

HOT WATER HEATING electric

FUEL BILL, F_B = $ 1239

K_1 = $ 0.218/litre

INTERIOR TEMP. (T_i) 21°C

DEGREE-DAYS (DD) 4674

AIR CHANGE/h (No.) 1.50

K_2 = 38,757,000

K_3 = 0.55

		PREVIOUS YEAR			HIGH AC/h = 1.50 #1 RETROFIT						
NO.	BUILDING COMPONENT	A	R_1	$Q_1 = \frac{A}{R_1}$	R_2	$Q_2 = \frac{A}{R_2}$	S_1	S_2	S_p	C	C/S
1	Ceiling	65.0	2.11	31	5.64	12	40	87	75		
2	Frame Walls	143.1	1.76	81	2.29	62	40	87	75		
3	Header joists	14.8	0.60	25							
4	Basement walls, A.G.	19.5	0.26	75	2.47	8	140	305	264		
5	Basement walls, B.G.	49.2	0.8	62	3.2	15	98	214	185		
6	Basement floor	65.0	4.6	14							
7	Windows	13.9	0.35	40							
8	Doors	3.7	0.70	5							
9											
10											
11	AIR CHANGE, Q = 0.361 x Vol. x No.		No. 1.50	261	No.						
12	TOTAL			594			318	693	599		

$$S_1 = F_B \times \frac{(Q_1 - Q_2)}{\text{TOTAL } Q_1}$$

ADD = DD + (T_i − 18) x b = 4674 + (21−18) x 161 = 5157

$$S_2 = 86,400 \times \text{ADD} \times \frac{K_1}{K_2 \times K_3} \times (Q_1 - Q_2)$$

$$= 4.557 \times (Q_1 - Q_2)$$

(a) TOTAL $S_2 \leq F_B$

$S_p = S_1 + 0.75\ (S_2 - S_1)$

(b) TOTAL $S_2 > F_B$

TOTAL S_p = TOTAL S_1 + 0.75 (F_B − TOTAL S_1)

CHART NO. 5

ENERGY SAVINGS CHART

(metric SI units)

NAME ______

ADDRESS ______

CITY OTTAWA PROV ONT

TYPE OF HOUSE 2-storey, detached

VOLUME OF HEATED SPACE 481.4 m^3

HEATING SYSTEM oil-fired, forced air

HOT WATER HEATING electric

FUEL BILL, F_B = $1239

K_1 = $ 0.218/litre

INTERIOR TEMP. (T_i) 21°C

DEGREE-DAYS (DD) 4674

AIR CHANGE/h (No.) 0.50

K_2 = 38,757,000

K_3 = 0.55

		PREVIOUS YEAR			Low AC/h = 0.50, #1 RETROFIT						
NO.	BUILDING COMPONENT	A	R_1	$Q_1 = \frac{A}{R_1}$	R_2	$Q_2 = \frac{A}{R_2}$	S_1	S_2	S_p	C	C/S
1	Ceiling	65.0	2.11	31	5.64	12	56	87	79		
2	Frame walls	143.1	1.76	81	2.29	62	56	87	79		
3	Header joists	14.8	0.60	25							
4	Basement walls, A.G.	19.5	0.26	75	2.47	8	197	305	278		
5	Basement walls, B.G.	49.2	0.8	62	3.2	15	139	214	195		
6	Basement floor	65.0	4.6	14							
7	Windows	13.9	0.35	40							
8	Doors	3.7	0.70	5							
9											
10											
11	AIR CHANGE, Q = 0.361 x Vol. x No.		No. 0.50	87	No.						
12	TOTAL			420			448	693	631		

$$S_1 = F_B \times \frac{(Q_1 - Q_2)}{\text{TOTAL } Q_1}$$

ADD = DD + (T_i − 18) × b = 4674 + (21−18) × 161 = 5157

$$S_2 = 86{,}400 \times \text{ADD} \times \frac{K_1}{K_2 \times K_3} \times (Q_1 - Q_2)$$

$$= 4.557 \times (Q_1 - Q_2)$$

(a) $\frac{\text{TOTAL } S_2 \le F_B}{S_p = S_1 + 0.75\ (S_2 - S_1)}$

(b) $\frac{\text{TOTAL } S_2 > F_B}{\text{TOTAL } S_p = \text{TOTAL } S_1 + 0.75\ (F_B - \text{TOTAL } S_1)}$

CHART No. 6

ENERGY SAVINGS CHART

(metric SI units)

NAME ______

ADDRESS ______

CITY OTTAWA PROV ONT.

TYPE OF HOUSE 2-storey, detached

VOLUME OF HEATED SPACE 481.4 m^3

HEATING SYSTEM oil-fired, forced air

HOT WATER HEATING electric

FUEL BILL, F_B = $ 1239

K_1 = $ 0.218/litre

INTERIOR TEMP. (T_i) 21°C

DEGREE-DAYS (DD) 4674

AIR CHANGE/h (No.) 1.50

K_2 = 38,757,000

K_3 = 0.55

		PREVIOUS YEAR			AIR CHANGE REDUCTION RETROFIT						
NO.	BUILDING COMPONENT	A	R_1	$Q_1 = \frac{A}{R_1}$	R_2	$Q_2 = \frac{A}{R_2}$	S_1	S_2	S_p	C	C/S
1	Ceiling	65.0	2.11	31							
2	Frame walls	143.1	1.76	81							
3	Header joists	14.8	0.60	25							
4	Basement walls, A.G.	19.5	0.26	75							
5	Basement walls, B.G.	49.2	0.8	62							
6	Basement floor	65.0	4.6	14							
7	Windows	13.9	0.35	40							
8	Doors	3.7	0.70	5							
9											
10											
11	AIR CHANGE, Q = 0.361 x Vol. x No.		No. 1.50	261	No. 0.75	130	273	597	516		
12	TOTAL			594							

$$S_1 = F_B \times \frac{(Q_1 - Q_2)}{\text{TOTAL } Q_1}$$

$$ADD = DD + (T_i - 18) \times b = \underline{4674 + (21-18) \times 161 = 5157}$$

$$S_2 = 86{,}400 \times ADD \times \frac{K_1}{K_2 \times K_3} \times (Q_1 - Q_2)$$

$$= \underline{4.557} \times (Q_1 - Q_2)$$

(a) $\frac{\text{TOTAL } S_2 \leq F_B}{S_p = S_1 + 0.75\ (S_2 - S_1)}$

(b) $\frac{\text{TOTAL } S_2 > F_B}{\text{TOTAL } S_p = \text{TOTAL } S_1 + 0.75\ (F_B - \text{TOTAL } S_1)}$

CONCLUDING REMARKS

This paper has presented a methodology to estimate heating-season energy savings from reinsulation of houses. Further savings would be achieved if a house had a cooling or air-conditioning system. Although the minimum (S_1) and maximum (S_2) savings are theoretically correct, the actual results can vary considerably since S_1 depends on the values selected for Q_1 (or R_1) and Q_2 (or R_2) while S_2 additionally depends on ADD (or T_i) and K_3.

Some factors influencing these parameters are as follows:

Q_1 and Q_2 (R_1 and R_2). - Failure to include thermal bridging effects in the calculation of R-values can result in the predicted S_1, S_2, and S_p being considerably higher than actual.

ADD (or T_i). - The S_2 calculations are affected by the accuracy of ADD which is dependent on the variable factor, T_i. Some houses, especially older ones, may have lower interior temperatures (T_i's) than realized (and used in calculations) because of high heat loss rates and non-uniform heating. This would result in the calculations predicting greater-than-actual S_2 and S_p values.

K_3. - The S_2 calculations depend on the seasonal efficiency of the heating system and assume that it is constant before and after reinsulation.

If the ratio of furnace rated output to building heat loss is increased by reinsulating (K_3 becomes smaller), the actual savings can decrease or even disappear. It is very important, therefore, to downsize the furnace where required.

ACKNOWLEDGEMENT

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APPENDIX A

CONVERSIONS FROM AND TO SI

TABLE A1 - CONVERSIONS FROM METRIC (SI) TO IMPERIAL

(Multiply the metric (SI) unit by the factor given in the equation to convert to imperial.)

Length	1 m = 3.281 ft
	1 mm = 0.0394 in.
Area	$1\ m^2 = 10.76\ ft^2$
Volume	$1\ m^3 = 1000$ litre
	$= 35.31\ ft^3$
	1 litre = 0.220 gallon
Mass	1 kg = 2.205 lb
Density	$1\ kg/m^3 = 0.0624\ lb/ft^3$
Temperature	9/5 °C + 32 = °F
Energy	$1\ J = 9.48 \times 10^{-4}$ Btu
	1 kJ = 0.948 Btu
Power	1 W = 1 J/s
	= 3.412 Btu/hr
R-Value	$1\ m^2\ °C/W = 5.678\ hr\ ft^2\ °F/Btu$
R/unit thickness	1 RSI/mm = 144.2 R/in.

TABLE A2 - IMPERIAL TO METRIC (SI) CONVERSIONS

(Multiply the imperial unit by the factor given in the equation to convert to metric (SI).)

Length	1 ft = 0.3048 m 1 in. = 25.4 mm
Area	1 ft^2 = 0.0929 m^2
Volume	1 litre = 0.001 m^3 1 gallon = 4.55 litre 1 ft^3 = 0.0283 m^3
Mass	1 lb = 0.454 kg
Density	1 lb/ft^3 = 16.03 kg/m^3
Temperature	5/9 (°F - 32) = °C
Energy	1 Btu = 1.05×10^3 J 1 Btu = 1.05 kJ
Power	1 J/s = 1 W 1 Btu = 0.293 W
R-Value	1 hr ft^2 °F/Btu = 0.1761 m^2 °C/W
R/unit thickness	1 R/in. = 0.00693 RSI/mm

APPENDIX B

THERMAL RESISTANCES

TABLE B1 - THERMAL RESISTANCE OF SOME COMMON BUILDING MATERIALS *

	Thermal Resistance			
Building Material	S.I.		imperial	
or Component	R/mm	For Thickness Listed	R/in.	For Thickness Listed
Insulation				
Fibreglass Batt	0.022	---	3.17	---
Rockwool Batt	0.023	---	3.32	---
Fibreglass Loose Fill (Blown-In)	0.015	---	2.16	---
Fibreglass Loose Fill (Poured)	0.021	---	3.03	---
Rockwool Loose Fill (Blown-In)	0.019	---	2.74	---
Rockwool Loose Fill (Poured)	0.021	---	3.03	---
Cellulose Fibre (Blown)	0.025	---	3.61	---
Cellulose Fibre (Poured)	0.024	---	3.46	---
Expanded Mica (Vermiculite, Zonolite, etc.)	0.016	---	2.31	---
Polystyrene Loose Fill	0.020	---	2.88	---
Expanded Polystyrene (Rigid)	0.027	---	3.89	---
Extruded Polystyrene (Rigid)	0.035	---	5.05	---
Polyurethane (Rigid)	0.042	---	6.06	---
Polyurethane (Foamed in Place)	0.042	---	6.06	---
Fibreglass Sheathing	0.031	---	4.47	---
Urea Formaldehyde (Foamed in Place, After Curing)	0.018	---	2.60	---
Wood Fibre	0.023	---	3.32	---
Wood Shavings	0.017	---	2.45	---
Cork	0.026	---	3.75	---
Glass Fibre Roof Board	0.028	---	4.04	---
Mineral Aggregate Board	0.018	---	2.60	---
Compressed Straw Board	0.014	---	2.02	---
Fibreboard	0.019	---	2.74	---
Structural Materials				
Softwood Lumber (except Cedar)	0.0087	---	1.25	---
Cedar Logs and Lumber	0.0092	---	1.33	---
Concrete 2400 kg/m^3 (150 lb/ft^3)	0.00045	---	0.06	---
Concrete 1760 kg/m^3 (110 lb/ft^3)	0.0013	---	0.19	---
Concrete 480 kg/m^3 (30 lb/ft^3)	0.0069	---	1.00	---

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* Handbook on Insulating Homes for Energy Conservation, E. Scheuneman, S. Moffatt and M. Adelaar, Canadian General Standards Board, CGSB 51-GP-42MP, Ottawa, July 1980.

TABLE B1 - THERMAL RESISTANCE OF SOME COMMON BUILDING MATERIALS (Cont'd)

Building Material or Component	Thermal Resistance			
	S.I.		imperial	
	R/mm	For Thickness Listed	R/in.	For Thickness Listed
Structural Materials (Cont'd)				
Concrete Block (3 Oval Core)				
Sand and Gravel Aggregate				
100 mm (4")	---	0.12	---	0.68
200 mm (8")	---	0.20	---	1.14
300 mm (12")	---	0.22	---	1.25
Cinder Aggregate				
100 mm (4")	---	0.20	---	1.14
200 mm (8")	---	0.30	---	1.70
300 mm (12")	---	0.33	---	1.87
Lightweight Aggregate				
100 mm (4")	---	0.26	---	1.48
200 mm (8")	---	0.35	---	1.99
300 mm (12")	---	0.40	---	2.27
Common Brick, Clay, 100 mm (4")	---	0.07	---	0.40
Common Brick, Concrete, 100 mm (4")	---	0.05	---	0.28
Stone (Lime or Sand)	0.00060	---	0.09	---
Steel	0.000022	---	0.0032	---
Aluminum	0.0000049	---	0.0007	---
Glass (No Air Films) 3 - 6 mm (1/8" - 1/4")	---	0.01	---	0.06
Air				
Enclosed Air Space (Non-Reflective)				
Heat Flow Up, 25 - 100 mm (1" - 4")	---	0.15	---	0.85
Heat Flow Down, 25 - 100 mm (1" - 4")	---	0.18	---	1.02
Heat Flow Horizontal, 25 - 100 mm (1" - 4")	---	0.17	---	0.97
Air Surface Films				
Outside Air Film (Moving Air)	---	0.03	---	0.17
Inside Air Film (Still Air)				
Horizontal, Heat Flow Up	---	0.11	---	0.62
Sloping 45°, Heat Flow Up	---	0.11	---	0.62
Vertical, Heat Flow Horizontal	---	0.12	---	0.68
Horizontal, Heat Flow Down	---	0.16	---	0.91
Attic Air Film	---	0.08	---	0.45

TABLE B1 - THERMAL RESISTANCE OF SOME COMMON BUILDING MATERIALS (Cont'd)

Building Material or Component	Thermal Resistance S.I. R/mm	Thermal Resistance S.I. For Thickness Listed	Thermal Resistance imperial R/in.	Thermal Resistance imperial For Thickness Listed
Roofing				
Asphalt Roll Roofing	---	0.03	---	0.17
Asphalt Shingles	---	0.08	---	0.45
Wood Shingles (Cedar Shakes)	---	0.17	---	0.97
Built-Up Membrane (Hot Mopped)	---	0.06	---	0.34
Crushed Stone (Not Dried)	0.00055	---	0.08	---
Sheathing Materials				
Softwood Plywood	0.0087	---	1.25	---
Mat-Formed Particle Board	0.0087	---	1.25	---
Insulating Fibreboard Sheathing	0.017	---	2.45	---
Gypsum Sheathing	0.0062	---	0.89	---
Sheathing Paper	0.00040	---	0.06	---
Asphalt-Coated Kraft Paper	Negli.	---	Negli.	---
Polyethylene Vapour Barrier	Negli.	---	Negli.	---
Cladding Materials				
Fibreboard Siding				
Medium Density Hardboard, 11 mm (7/16")	---	0.10	---	0.57
High Density Hardboard, 11 mm (7/16")	---	0.08	---	0.45
Softwood Siding (Lapped)				
Drop, 18 × 184 mm (3/4" × 7 1/4")	---	0.14	---	0.79
Bevel, 12 × 184 mm (1/2" × 7 1/4")	---	0.14	---	0.79
Bevel, 18 × 235 mm (3/4" × 9 1/4")	---	0.18	---	1.02
Plywood, 9 mm (3/8")	---	0.10	---	0.57
Wood Shingles	---	0.17	---	0.97
Brick (Clay or Shale) 100 mm (4")	---	0.08	---	0.45
Brick (Concrete, Sand-Lime) 100 mm (4")	---	0.05	---	0.28
Stucco, 25 mm (1")	0.0014	0.03	0.20	0.17

TABLE B1 - THERMAL RESISTANCE OF SOME COMMON BUILDING MATERIALS (Cont'd)

Building Material or Component	Thermal Resistance S.I. R/mm	Thermal Resistance S.I. For Thickness Listed	Thermal Resistance imperial R/in.	Thermal Resistance imperial For Thickness Listed
Cladding Materials (Cont'd)				
Metal Siding				
Horizontal Clapboard Profile	---	0.12	---	0.68
Horizontal Clapboard with Backing	---	0.25	---	1.42
Vertical V-Groove Profile	---	0.12	---	0.68
Vertical Board and Batten Profile	---	Negli.	---	Negli.
Interior Finishes				
Gypsum Board, Gypsum Lath, Drywall, 13 mm (1/2")	0.0062	0.08	0.89	0.45
Gypsum Plaster				
Sand Aggregate, 13 mm (1/2")	0.0014	0.02	0.20	0.11
Lightweight Aggregate, 13 mm (1/2")	0.0044	0.06	0.63	0.34
Plywood, 7.5 mm (5/16")	0.0093	0.07	1.34	0.40
Hardboard, (Standard), 6 mm (1/4")	0.0053	0.03	0.76	0.17
Insulating Fibreboard, 25 mm (1")	0.017	0.42	2.45	2.38
Flooring				
Maple or Oak (hardwood), 19 mm (3/4")	0.0063	0.12	0.91	0.68
Pine or Fir (softwood), 19 mm (3/4")	0.0089	0.17	1.28	0.97
Plywood, 16 mm (5/8")	0.0088	0.14	1.27	0.79
Mat-formed Particle Board, 16 mm (5/8")	0.0088	0.14	1.27	0.79
Wood Fibre Tiles, 13 mm (1/2")	0.016	0.21	2.31	1.19
Linoleum, Tile (resilient), 3 mm (1/8")	---	0.01	---	0.06
Terrazzo, 25 mm (1")	0.00056	0.01	0.08	0.06
Carpet, Typical Thickness				
with Fibrous Underlay	---	0.37	---	2.10
with Rubber Underlay	---	0.23	---	1.31

TABLE B1 - THERMAL RESISTANCE OF SOME COMMON BUILDING MATERIALS (Cont'd)

Building Material or Component	Thermal Resistance S.I. R/mm	S.I. For Thickness Listed	imperial R/in.	imperial For Thickness Listed
Windows (including inside and outside air films)				
Single Glass	---	0.15	---	0.85
Insulated Glass (Double Pane)				
5 mm (3/16") Air Space	---	0.25	---	1.42
6 mm (1/4") Air Space	---	0.27	---	1.53
13 mm (1/2") Air Space	---	0.30	---	1.70
19 mm (3/4") Air Space	---	0.33	---	1.87
Insulated Glass (Triple Pane)				
6 mm (1/4") Air Space	---	0.38	---	2.16
13 mm (1/2") Air Space	---	0.49	---	2.78
19 mm (3/4") Air Space	---	0.50	---	2.84
Storm Windows				
Single Pane + 25 - 100 mm (1" - 4") Air Space	---	0.35	---	1.99
19 mm (3/4") Sealed Unit + 25 - 100 mm (1" - 4") Air Space	---	0.49	---	2.78

Thermal Resistance Values for Basements

The basement wall above grade and the basement wall and floor below grade are treated separately. The foundation wall above grade is exposed to outside air temperatures and behaves in much the same way as other above-grade construction. The below-grade portion requires special consideration, however, because other factors must be taken into account to obtain the thermal resistance values shown in Table B2. These values were obtained from measured results and will be revised as more information about below-grade heat losses becomes available.

If the desired insulation requirements do not exactly match those shown in Table B2, the one that most clearly approximates the desired value should be chosen. As the R-values for various construction types are not linear functions, they should not be interpolated from these values.

TABLE B-2 - PROVISIONAL THERMAL RESISTANCE VALUES FOR BELOW-GRADE CONSTRUCTION IN CANADA

For 200 mm (8 in.) concrete foundation wall

	Thermal Resistance	
	S.I.	(imperial)
Without insulation	0.8	(4.5)
With insulation 610 mm (24") below grade and 1220 mm (48") uninsulated		
R 0.70 (R4) insulation	0.9	(5.1)
R 1.41 (R8) insulation	1.1	(6.2)
R 2.11 (R12) insulation	1.2	(6.8)
R 3.52 (R20) insulation	1.3	(7.5)
With insulation down to footing		
R 0.70 (R4) insulation	1.8	(10)
R 1.41 (R8) insulation	2.5	(14)
R 2.11 (R12) insulation	3.2	(18)
R 3.52 (R20) insulation	3.9	(22)
Concrete floor	4.6	(26)

APPENDIX C

THERMAL BRIDGING IN WALLS AND CEILINGS

Thermal bridging refers to the effect of heat flowing at different rates through a building component due to different materials in the component. The most common example in housing is the presence of wall studs and ceiling joists which have a different heat flow or heat resistance (R-value) from the rest of the wall and ceiling area. Thermal bridging alters the nominal resistance (R) values of walls and ceilings and should be considered when calculating the thermal resistance of a building component, both before and after upgrading.

For example, in most houses the wall studs comprise about 20% of the net wall area and ceiling joists about 10% of the ceiling area. The formulae to calculate the R values for these houses would be:

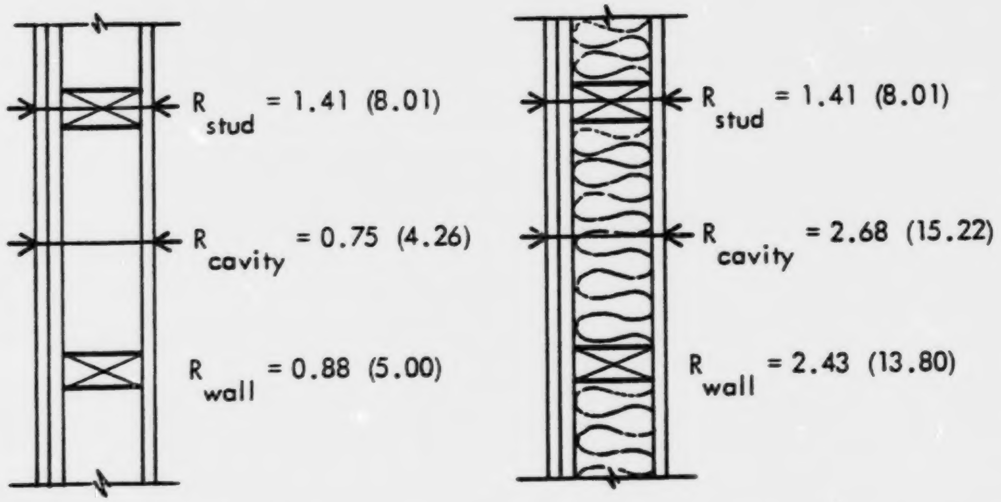
$$R\ \text{wall} = 0.80\ R\ \text{cavity} + 0.20\ R\ \text{stud}$$

$$R\ \text{ceiling} = 0.90\ R\ \text{cavity} + 0.10\ R\ \text{joist}$$

This is referred to as a parallel heat flow calculation.

Example 1

The example of a wall, shown in Figure C-1, illustrates the effects on R-values and savings.



R_{stud} = 1.41 (8.01)
R_{cavity} = 0.75 (4.26)
R_{wall} = 0.88 (5.00)
R_{stud} = 1.41 (8.01)
R_{cavity} = 2.68 (15.22)
R_{wall} = 2.43 (13.80)

(a) UNINSULATED WALL
(BEFORE REINSULATION)

(b) INSULATED WALL
(AFTER REINSULATION)

Fig. C-1 Thermal Bridging Effect of Wall Studs

It can be seen for: (a) that the thermal bridging increases the over-all R-value by 17%, (0.88 - 0.75) ÷ 0.75 × 100 and for (b) it decreases the over-all R-value by 9%, (2.68 - 2.43) ÷ 2.68 × 100.

Using F_B = \$1239 and A = 143.1 values from the text example, we can examine the effects on the savings as follows:

(i) Using R-values without accounting for thermal bridging:
Total $Q_1 = 511 + 191 - 81 = 621$

(ii) Using R-values accounting for thermal bridging:
Total $Q_1 = 511 + 163 - 81 = 593$

		A	R_1	Q_1	R_2	Q_2	S_1	S_2	S_p
Walls	(i)	143.1	0.75	191	2.68	53	\$275	\$629	\$541
	(ii)	143.1	0.88	163	2.43	59	\$217	\$474	\$410

Case (i) gives results for S_1, S_2 and S_p that are high by 27%, 33%, and 32% respectively. This demonstrates the importance of accounting for thermal bridging effects.

The percent error will vary for different situations as shown by Example 2.

Example 2

Using the wall from the example in the main text (assuming these are nominal values only) and the R stud value from Figure C-1, one can use the parallel heat flow calculation to obtain corrected R-values as follows:

$$R_1 = 0.80\ (1.76) + 0.20\ (1.41) = 1.69$$
$$R_2 = 0.80\ (2.29) + 0.20\ (1.41) = 2.11$$

(i) Nominal calculation:
Total $Q_1 = 511 + 81 - 81 = 511$

(ii) Parallel heat flow calculation:
Total $Q_1 = 511 + 85 - 81 = 515$

		A	R_1	Q_1	R_2	Q_2	S_1	S_2	S_p
Walls	(i)	143.1	1.76	81	2.29	62	\$46	\$87	\$77
	(ii)	143.1	1.69	85	2.11	68	\$41	\$77	\$68

Case (i) again gives results for S_1, S_2 and S_p that are high by 12%, 13%, and 13% respectively.

APPENDIX D

DEGREE-DAYS (DD) AND ACTUAL DEGREE-DAYS (ADD)

Degree-Days (DD)

Heating degree-days is a measure used to estimate heating energy consumed. Past measurements revealed that the fuel consumed in small buildings was roughly proportional to the difference between an indoor temperature of 65°F (≈18°C) and the outdoor temperature; consequently degree days (DD) were tabulated using a base of 65°F (≈18°C). This empirical correlation has served well but, because of changes to insulation levels in buildings and particularly the increased use of electrical appliances, this relation is no longer adequate.

Actual Degree-Days (ADD)

Many houses today seem to require heating only when the outdoor temperature is below freezing. It was decided, therefore, that the actual indoor/outdoor temperature difference would provide a more useful measure for computation. The true thermal load on a house could be determined using actual degree-days (ADD); the contribution of the internal heat gains would be reconsidered in some other way.

Table D1 is a list of actual degree-day (ADD) values based on an indoor temperature (T_i) of 21°C (70°F). The values were computed using an approximation method and are believed to be within a 5% accuracy.

For values not listed in Table D1 or for an interior temperature, T_i, other than 21°C (70°F), the ADD may be computed from the following formula:

$$ADD = DD + (T_i - 18) \times b \quad (\text{Imperial: } ADD = DD + (T_i - 65) \times b)$$

where DD = degree-days for location*
T_i = interior temperature
b = constant factor from location on map in Figure D-1

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* This value can be obtained from the local weather office, CMHC office, electric utility office, library, The Supplement to the National Building Code of Canada, 1980, pp. 11-21, NRCC No. 17724 or Atmospheric Environmental Service, 4905 Dufferin Street, Downsview, Ontario, M3H 5T4, Phone: 416-667-4917.

The temperature, T_i, may be measured or approximated as the thermostat setting. For example, a house in Winnipeg has a constant thermostat setting of 22°C; hence, T_i = 22°C (72°F) and DD = 5887 (10679). From Figure D-1 the b for Winnipeg is 161 (290) which gives

$$ADD = 5887 + (22 - 18) \times 161 = 6531$$
$$(ADD = 10679 + (72 - 65) \times 290 = 12709)$$

Many occupants, however, are practicing thermostat setback, i.e., the thermostat setting is turned down at night or other times. For these situations the following formula can be used to estimate an average T_i:

$$T_i = \frac{h_1}{24} T_1 + \frac{h_2}{24} T_2$$

where h_1 = number of hours/day at temperature T_1

h_2 = number of hours/day at temperature T_2

For example, a house has thermostat settings as follows:

T_1 = 21°C (70°F) from 8 am to 10 pm (i.e., $h_1 = 14$)

T_2 = 16°C (61°F) from 10 pm to 8 am (i.e., $h_2 = 10$)

Therefore,

$$T_i = \frac{14}{24} (21) + \frac{10}{24} (16) = 19°C$$

$$(T_i = \frac{14}{24} (70) + \frac{10}{24} (61) = 66°F)$$

and hence for a house in Winnipeg

$$ADD = DD + (T_i - 18) \times b$$
$$= 5887 + (19 - 18) \times 161 = 6048$$
$$(ADD = 10679 + (66 - 65) \times 290 = 10969)$$

TABLE D1 - ACTUAL DEGREE-DAYS (ADD) BELOW 21°C (70°F) FOR SELECTED LOCATIONS IN CANADA*

Location	°C (ADD)	(°F)
Northwest Territories		
Alert	13727	25313
Frobisher Bay	10453	19701
Yellowknife	9125	17234
Yukon		
Dawson	8806	16667
Whitehorse	7412	14075
Newfoundland		
St. John's	5336	10591
Grand Falls	5440	10877
Corner Brook	5312	10578
Prince Edward Island		
Charlottetown	5130	10011
Nova Scotia		
Halifax	4630	8886
Sydney	4966	9574
Yarmouth	4558	8940
New Brunswick		
Moncton	5214	10236
Edmundston	5767	11246
Fredericton	5182	10121
Saint John	5278	9978
Québec		
Montréal	4955	9653
Québec	5587	10462
Sept Iles	6703	13027
Gaspé	5906	11400
Drummondville	5161	10150
Schefferville	8761	16480
St. Jean	4997	10025
Trois Rivières	5436	10756
Ontario		
Toronto	4565	8277
Ottawa	5157	10143
Timmins	6695	12925
North Bay	5825	11202
Kenora	6413	12246
London	4541	8774
Sault Ste Marie	5596	11025
Thunder Bay	6251	11930
Manitoba		
Winnipeg	6370	12129
Thompson	8437	15425
Morden	6086	11518
Churchill	9781	18428
The Pas	7358	13806
Saskatchewan		
Saskatoon	6551	12281
Regina	6395	12231
Maple Creek	5408	10925
North Battleford	6549	12507
Alberta		
Calgary	5851	11228
Edmonton	6097	11793
Fort Vermilion	7584	14638
Lethbridge	5200	10094
British Columbia		
Vancouver	3539	7115
Victoria	3609	7179
Kamloops	4229	8224
Fort Nelson	7571	14302
Prince George	5894	11280

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* These °C and °F values cannot be directly converted from one to the other, as 21°C is not exactly equal to 70°F

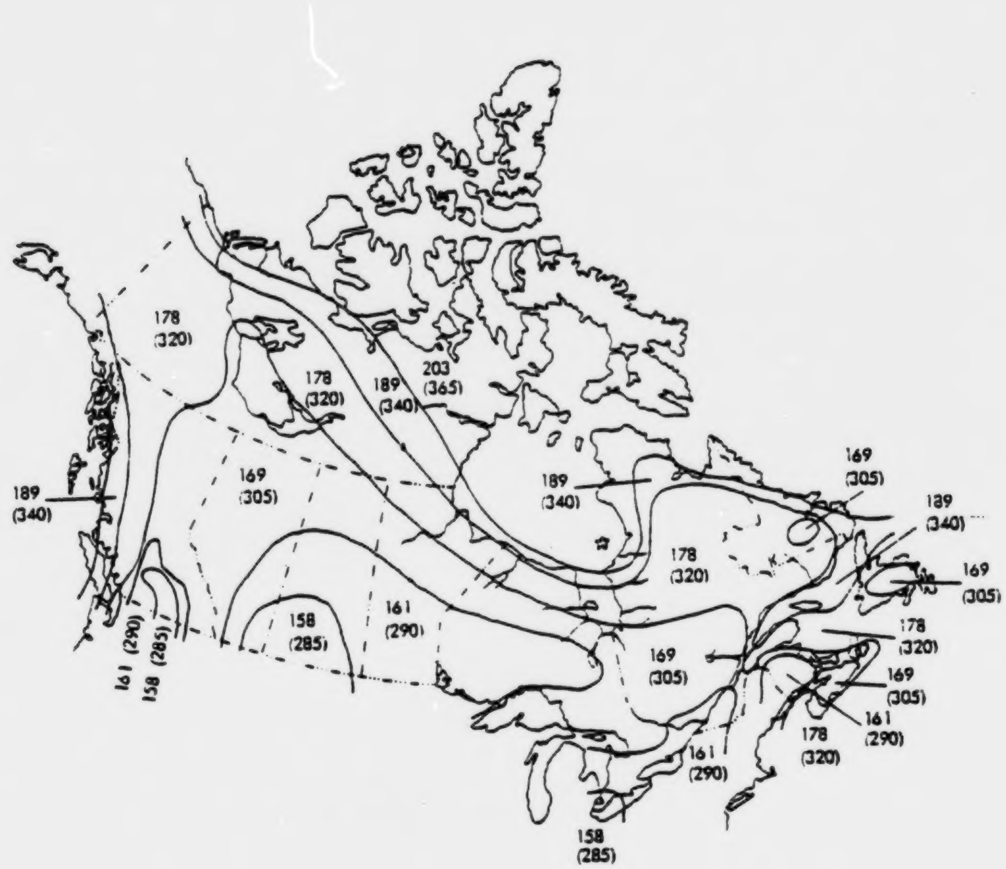
178
(320)
178
(320)
189
(340)
203
(365)
169
(305)
189
(340)
189
(340)
169
(305)
189
(340)
178
(320)
169
(305)
161
(290)
158
(285)
161 (290)
158 (285)
169
(305)
178
(320)
169
(305)
161
(290)
178
(320)
161
(290)
158
(285)

FIGURE D-1

APPROXIMATE DEGREE DAYS PER DEGREE FROM 18°C (65°F) TO 24°C (75°F)

APPENDIX E

SEASONAL EFFICIENCY OF HEATING SYSTEMS (K_3)

The steady-state efficiency of the heating system is the efficiency obtained when the system has reached its optimum operating conditions.

The seasonal efficiency, is the efficiency obtained over the heating season as the average of the efficiencies obtained when the system is operating under both optimum and during less than optimum conditions. Hence, the seasonal efficiency is usually lower, often considerably lower, than the steady-state efficiency. The amount of time spent in non-optimum operation relative to optimum operation determines the difference between steady-state and seasonal efficiencies.

This Appendix deals with the heating efficiency of only the following: electricity, gas, and oil. It also includes the numerical determination of seasonal efficiency, K_3. A system that is 100% seasonally efficient would have a K_3 of 1.00 whereas a system that is 70% seasonally efficient would have a K_3 of 0.70.

Electricity

It is generally accepted that both the seasonal and steady-state efficiencies of electric heating systems are 100%. Hence, for space heating by baseboard heaters or forced-air furnaces, the value of K_3 is 1.00.

Gas and Oil

The steady-state efficiencies of gas and oil furnace heating systems are considerably less (by 20-25%) than 100% because of the combustion process and other factors. Seasonal efficiencies are less than the steady-state efficiencies because gas and oil furnaces require 5-10 minutes after each start-up to reach optimum (steady-state) operating conditions. If a furnace is oversized relative to the house heating load, the furnace on-time of the furnace cycle is shorter. This results in a lower seasonal efficiency because of the higher ratio of non-optimum to optimum operation time. After reinsulating, the house heating load has been reduced and the furnace should be adjusted to reduce its output capacity to match the new reduced load.

Little can be done to reduce the capacity of gas furnaces except by replacing them. The capacity of an oil-fired furnace, however, can be reduced by replacing the oil burner nozzle. At present, the nozzle can only be reduced to one size lower than the CSA rating without voiding certification. If a retention head burner is retrofitted, further reduction is encouraged.

Determination of K_3 for Gas and Oil Furnaces

The following information and procedure apply to older furnaces and may not apply to newer gas and oil furnaces with features such as electronic ignition, retention head burner, and solenoid valve.

If it is not feasible to determine K_3 by the following technique, the value 0.55 may be used as a "default" or "best guess" value for both gas and oil furnaces.

The first step is to calculate the building heat loss using the following formula:

$$\text{building heat loss} = \text{Total } Q_1 \times (T_i - T_D)$$

where Total Q_1 = sum of Q_1's

- found in row 12 of Column Q_1 in the Energy Savings Chart. (For example, Total Q_1 = 511 from Chart 2.)

$(T_i - T_D)$ = design temperature difference

where T_i is the previously calculated interiour house temperature and T_D is the 2 1/2% January Design Temperature from Table E-1.

The second step is to find the furnace rated output which is usually called bonnet capacity and stamped on a plate on the casing of oil furnaces. For gas furnaces one takes the rated input shown on the furnace plate and multiplies it by 0.75 which yields the furnace rated output. (Remember to convert these values to metric if working with metric units.)

The third step is to calculate the furnace overfiring capacity by putting the foregoing two quantities into the following equation and carrying out the numerical calculation.

$$\text{furnace overfiring} = \frac{\text{furnace rated output} - \text{building heat loss}}{\text{building heat loss}} \times 100\%$$

The fourth step is to measure or calculate the steady-state efficiency of the furnace. This can be measured by having a furnace efficiency test carried out on oil and gas furnaces.* It may be calculated for oil, but not gas, furnaces using the following equation:

$$\text{steady-state efficiency} = \frac{\text{bonnet capacity}}{\text{firing rate} \times 140{,}000}$$

where

- bonnet capacity is read off furnace plate
- firing rate is read off furnace plate

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* For details see The Billpayer's Guide to Furnace Servicing, EMR, 1975, pp. 40-43 and 59-61

TABLE E1 - JANUARY 2½% DESIGN TEMPERATURES FOR SELECTED LOCATIONS IN CANADA

Location	Design Temperature °C	(°F)
Northwest Territories		
Alert	-43	(-45)
Frobisher Bay	-40	(-40)
Yellowknife	-43	(-45)
Yukon		
Dawson	-50	(-58)
Whitehorse	-41	(-42)
Newfoundland		
St. John's	-14	(7)
Grand Falls	-21	(-6)
Corner Brook	-19	(-2)
Prince Edward Island		
Charlottetown	-20	(-4)
Nova Scotia		
Halifax	-16	(3)
Sydney	-16	(3)
Yarmouth	-13	(9)
New Brunswick		
Moncton	-22	(-8)
Edmundston	-27	(-17)
Fredericton	-24	(-11)
Saint John	-22	(-8)
Québec		
Montréal	-23	(-9)
Québec	-25	(-13)
Sept Iles	-30	(-22)
Gaspé	-23	(-9)
Drummondville	-25	(-13)
Schefferville	-28	(-36)
St. Jean	-24	(-11)
Trois Rivières	-25	(-13)

Location	Design Temperature °C	(°F)
Ontario		
Toronto	-18	(0)
Ottawa	-25	(-13)
Timmins	-34	(-29)
North Bay	-28	(-18)
Kenora	-33	(-27)
London	-18	(0)
Sault Ste Marie	-25	(-13)
Thunder Bay	-31	(-24)
Manitoba		
Winnipeg	-33	(-27)
Thompson	-42	(-44)
Morden	-31	(-24)
Churchill	-39	(-38)
The Pas	-36	(-33)
Saskatchewan		
Saskatoon	-35	(-31)
Regina	-34	(-29)
Maple Creek	-31	(-24)
North Battleford	-34	(-29)
Alberta		
Calgary	-31	(-24)
Edmonton	-32	(-26)
Fort Vermilion	-41	(-42)
Lethbridge	-30	(-22)
British Columbia		
Vancouver	-7	(19)
Victoria	-5	(23)
Kamloops	-25	(-13)
Fort Nelson	-40	(-40)
Prince George	-33	(-27)

For other Canadian locations see "The Supplement to the National Building Code of Canada, 1980," pp. 11-21, NRCC No. 17724. (Price: $7.30)

The final step is to use the overfiring capacity and steady-state efficiency with Table E2 to find the seasonal efficiency, K_3

TABLE E2 - APPARENT SEASONAL EFFICIENCY OF OIL- AND GAS-FIRED FURNACE (K_3)

Rated Steady State Efficiency of Furnace	Overfiring Capacity				
	0	20	40	60	80
0.80	0.67	0.64	0.62	0.59	0.57
0.75	0.63	0.60	0.58	0.56	0.54
0.70	0.58	0.56	0.54	0.52	0.50
0.65	0.54	0.52	0.50	0.48	0.46
0.60	0.50	0.48	0.46	0.44	0.43

APPENDIX V

CEDURE DEVELOPMENT TECHNICAL BACKUP

Appendix V-A

Retrofit Options and Costs

NEWFOUNDLAND AND LABRADOR HOME ENERGY ADVISORY SERVICE

RETROFIT OPTIONS AND COSTS

INSULATION MEASURES

BASEMENT WALLS

Existing Condition	Proposed Retrofit	Materials	Contractor Installed Cost
no insulation	interior - RSI 1.2 (R-7) from top of concrete basement wall down to 1.2 m (4'-0") above slab	RSI 1.2 fiberglass batts 38 x 64 (2 x 3) framing 6 mil polyethylene vapour barrier 13 mm (1/2") drywall	$ 40.80 per running meter
	interior - RSI 1.2 (R-7) to full height of foundation wall	RSI 1.2 fiberglass batts 38 x 64 (2 x 3) framing 6 mil polyethylene vapour barrier 13 mm (1/2") drywall	$ 43.90 per running meter
	interior - RSI 2.1 (R-12) to full height of foundation wall (USED IN PROGRAM)	RSI 2.1 fiberglass batts 38 x 39 (2 x 4) framing 6 mil polyethylene vapour barrier 13 mm (1/2") drywall	$ 45.78 per running meter
	interior - RSI 1.7 (R-10) to full height of foundation wall	50 mm (2") extruded polystyrene 13 mm (1/2") drywall framing	$ 61.20 per running meter
uninsulated masonry and stone basements or basements where insulating from interior is not possible	exterior - RSI 1.7 (R-10) insulation from top of exposed masonry foundation down 0.6 m (2 feet) below grade and out horizontally 0.6 m (2'-0")	50 mm (2") extruded polystyrene flashing to protect top edge of insulation wire lathe and stucco to protect exposed surface area of insulation	$ 64.50 per running meter for 1.2 m above grade
RSI 1.2 (R-7) batts installed internally to 1.2 m (4'0") above slab	upgrade insulation to RSI 2.1 to full height of foundation wall	38 x 89 (2 x 4) stud wall RSI 2.1 (R-12) fiberglass batts 13 mm (1/2") drywall	$ 51.50 per running meter
flag polystyrene sheets installed and exposed internally (estimate 2" expanded polystyrene - white beadboard)	insulation should be covered to meet firecode - opportunity to upgrade with additional RSI 2.1 (R-12) fiberglass batts	38 x 39 (2 x 4) stud wall RSI 2.1 (R-12) fiberglass batts 13 mm (1/2") drywall	$ 51.50 per running meter

INSULATION MEASURES (Cont'd)

FLOORS OVER UNHEATED CRAWL SPACES (Cont'd)

Existing Condition	Proposed Retrofit	Materials	Contractor Installed Cost
no insulation (cont'd)	add RSI 4.2 (R-24) fiberglass batts and RSI 1.7 (R-10) 50 mm (2") blue extruded polystyrene for a total RSI 5.9 (R-34)	RSI 4.2 (R-24) batts RSI 1.7 (R-10) 50 mm (2") blue extruded polystyrene	$ 26.25/m^2
RSI 2.1 (R-12) batts between floor joists	add additional RSI 2.1 (R-12) batts between floor joists	RSI 2.1 (R-12) fiberglass batts nails and fishing line (or wire lathe or stapping) to support polyethylene ground cover	$ 11.20/m^2

ABOVE GRADE STUD WALLS

Existing Condition	Proposed Retrofit	Materials	Contractor Installed Cost
no insulation	*caulk and seal existing exterior add 50 mm (2") extruded polystyrene reside house	good grade silicone caulking 50 mm (2") extruded polystyrene sheathing (or strapping) wood siding (option vinyl siding)	$ 44.80/m^2
	*remove exterior siding seal back of interior surface as much as possible add RSI 2.1 (R-12) fiberglass batts reside house	good grade silicone caulking and foam RSI 2.1 (R-12) fiberglass batts sheathing or strapping wood siding	$ 43.25/m^2
RSI 1.2 (R-7) in cavity	*caulk and seal existing exterior wall add 50 mm (2") extruded polystyrene reside house	good grade silicone caulking 50 mm (2") extruded polystyrene sheathing or strapping wood siding	$ 44.80/m^2

*Note: Measures to be recommended only if surface needs upgrading
Costs to upgrade from interior prohibitive

INSULATION MEASURES (Cont'd)

SLAB ON GRADE

Existing Condition	Proposed Retrofit	Materials	Contractor Installed Cost
uninsulated	• add RSI 1.7 (R-10) extruded polystyrene	RSI 1.7 (R-10) extruded polystyrene (blue) expanded metal lathe masonry cement	Not Applicable

EXPOSED FLOORS

Existing Condition	Proposed Retrofit	Materials	Contractor Installed Cost
uninsulated	• add RSI 4.9 (R-28) fiberglass batts (USED IN PROGRAM)	RSI 4.9 (R-28) fiberglass batts 6 mil pelyethylene vapour barrier	$ 43.60/m^2
	• add RSI 3.4 (R-20) blown in fiberglass insulation	RSI 3.4 (R-20) 235 mm (9.25") blown in fiberglass insulation	$ 7.00/m^2

FLOORS OVER UNHEATED CRAWL SPACES

Existing Condition	Proposed Retrofit	Materials	Contractor Installed Cost
no insulation	• add RSI 2.1 (R-12) batts	RSI 2.1 (R-12) fiberglass batts nails and fishing line to support (or wire lathe or strapping) polyethylene ground cover	$ 11.30/m^2
	add RSI 4.2 (R-24) batts	RSI 4.2 (R-24) fiberglass batts; nails and fishing line to support polyethylene ground cover	$ 15.00/m^2
	add RSI 1.7 (R-10)	50 mm (2") blue extruded polystyrene nailed to underside of joists polyethylene ground cover	$ 15.20/m^2

INSULATION MEASURES (Cont'd)

ATTIC OR ROOF SPACE

Existing Condition	Proposed Retrofit	Materials	Contractor Installed Cost
site framing - low slope gable or flat roof no insulation	insulating and reroofing on the exterior overtop existing roof - "inverted" roof system (USED IN PROGRAM)	RSI 4.2 (R-24) 152 mm (6") Type 2 expanded polystyrene, tar and gravel (light color) roofing, metal fascia and wood blocking at edges	$ 28.00/m²
		RSI 3.5 (R-20) 100 mm (4") extruded polystyrene tar and gravel (light color) roofing, metal fascia and wood blocking at edges,	$ 25.80/m²
		Option - additional 133 mm (5 1/4") blown in loose fill fiberglass insulation RSI 2.0 (R-12) additional added	$ 10.70/m²
site framing - 1 1/2 storey structure no insulation	inslating and reroofing over the existing roofing	RSI 3.5 (R-20) 100 mm (4") extruded polystyrene sheathing, light colored shingles metal fascia and wood blocking at edges.	$ 45.60/m²
		Option - additional 133 mm (5 1/4") blown in loose fiberglass insulation RSI 2.0 (R-12) additional added	$ 7.00/m²
	eave crawl space floor add RSI 4.9 (R-28) fiberglass batts	remove flooring (if any) RSI 4.9 (R-28) fiberglass batts replace flooring	$ 12.20/m²
	knee wall add RSI 2.1 (R-12) fiberglass batts (USED IN PROGRAM)	RSI 2.1 (R-12) fiberglass batts strapping	$ 8.60/m²
	attic space add 305 mm (12") batts to RSI 7.1 (R-40)	RSI 7.1 (R-40) fiberglass batts attic vents as required	$ 14.10/m²

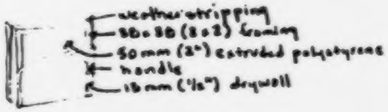
note: levels changed from
Enerplan

INSULATION MEASURES (Cont'd)

ATTIC OR ROOF SPACE (Cont'd)

Existing Condition		Proposed Retrofit	Materials	Contractor Installed Cost
site framing of trusses accessible attic space	•	*add 230 mm (9") batts to RSI 5.3 (R-30)	RSI 5.3 batts and vents	\$ 9.70/m^2 DIY - \$ 6.80/m^2
no insulation		*add 305 mm (12") batts to RSI 7.1 (R-40)	RSI 7.1 batts and vents	\$ 12.05/m^2 DIY - \$ 8.40/m^2
100 mm (4") fiberglass batts RSI 2.1 (R-12)	•	*add 152 mm (6") batts to RSI 5.6 (R-32)	RSI 3.5 batts and vents	\$ 6.80/m^2 DIY - \$ 4.20/m^2
		*add 230 mm (9") batts to RSI 7.6 (R-43)	RSI 5.3 batts and vents	\$ 9.70/m^2 DIY - \$ 6.80/m^2
152 mm (6") fiberglass batts RSI 3.5 (R-20)		*add 152 mm (6") batts to RSI 7.1 (R-40) (USED IN PROGRAM)	RSI 3.5 batts and vents	\$ 6.80/m^2 DIY \$ 4.20/m^2
				DIY Do-It-Yourself

GLAZING

Existing Condition		Proposed Retrofit	Materials	Contractor Installed Cost	
single glazing	•	installation of storm windows (USED IN PROGRAM)	metal sash storm windows wood sash storm windows	\$ 130 \$ 145	
single glazing		installation of insulating shutters	 weatherstripping 38x38 (2x2) framing 50 mm (2") extruded polystyrene handle 13 mm (½") drywall	\$ 226/m^2	
horizontal sliders with high infiltration rates (eg. Pearson, vinyl sliders)		replacement of window unit	good quality double glazed casements (or awnings)	sm (1.m^2) med (1.5 m^2) lg (2.0 m^2)	\$ 419 \$ 500 \$ 588
double glazing		install storm windows on north, west and east facades	metal sash storm windows wood sash storm windows	\$ 145 \$ 130	

* NOTE: Addition of insulation tied to attic venting - 1 sq. ft. of venting for each 150 sq. ft. area insulated if no vapour, 1 sq. ft. of venting for each 300 sq. ft. area insulated if vapour barrier is present - This amount is increased if venting is screened or louvered. Vents should be placed to encourage airflow from low to high in the attic space.

AIR TIGHTNESS MEASURES

approached with caution in houses without vapour barriers

Existing Condition		Proposed Retrofit	Materials	Contractor Installed Cost
conventional door improper seal	•	weatherstrip and caulk rehang if necessary (USED IN PROGRAM)	good quality (durable) weatherstripping and caulking	$ 48
conventional door poor insulating value	•	add storm door (include measure above) (USED IN PROGRAM)	storm door good quality weatherstripping and caulking	$ 270
windows (and frames) poorly maintained	•	caulk (USED IN PROGRAM) reset glazing where necessary weatherstrip install sash locks where applicable replace broken glazing	good quality caulking and weatherstripping	sm. (1 m^2) $ 80 med. (1.5 m^2) $ 80 lg. (2.0 m^2) $ 80
absence of vapour barrier		install vapour barrier using two coats of paint on walls and ceiling, combine with next sealing measure	vapour barrier or oil based paint	$ 7.40/m^2 not less than 74 m^2
leakage in building envelope	•	caulk, and foam (where applicable) at top of concrete and sill plate, top of joints and subfloor, at butt joints in header, at baseboards and around windows and doors	good quality caulking and foaming material	$ 250 – $ 400 per house
leakage at wall switches and outlets		install gaskets	foam gaskets	homeowner installed measure $ 5/house materials only
conventional attic hatch		insulate, seal, and provide with sash locks	good quality weatherstripping batts or polystyrene (assume RSI 3.5 (R-20) batts), sash locks	$ 60.00
dryer vented to outside		clean lint install vent damper	exterior vent damper	homeowner installed measure $ 20/ dryer vent

AIR TIGHTNESS MEASURES (Cont'd)

Existing Condition	Proposed Retrofit	Materials	Contractor Installed Cost
open chimney over fireplace	install fireplace plug	sheet metal insulated plug for standard opening	$ 144.00
excess humidity	existing forced air system add air to air heat exchanger	air to air heat exchanger	$ 1,600/house
	fan operated by humidistat	humidistat exhaust fan	$ 300/fan and humidistat
	dehumidifier	dehumidifier	$ 140

DOMESTIC HOT WATER SYSTEMS

Existing Condition	Proposed Retrofit	Materials	Contractor Installed Cost
Standby losses to hot water	• Insulate tank to RSI 3.5 (R-20) (USED IN PROGRAM)	Insulating blanket (+ tape)	$ 30/heater
Uncontrolled flow of hot water in bathroom and kitchen	• Install flow restrictors (high pressure/low volume faucet heads) (USED IN PROGRAM)	Flow restrictors	$ 30/house (Shower head and taps)
Hot water tank temperature above $50^{\circ}C$ ($120^{\circ}F$) assume at $65^{\circ}C$ ($150^{\circ}F$)	• Readjust thermostat to $50^{\circ}C$ ($120^{\circ}F$) (USED IN PROGRAM)		No Cost
Tankless coil oil range-flag if range frequently used to heat water only	Convert to electric hot water tank	Electric hot water tank; insulating jacket; piping connections	$ 240
Tankless coil oil furnace	Convert to electric hot water tank	Electric hot water tank; insulating jacket, piping connections	$ 240
Propane fired hot water tank	Retrofit options covered above		

HEATING SYSTEMS

Existing Condition		Proposed Retrofit	Materials	Contractor Installed Cost
poor maintenance poor efficiency oil fired furnace	•	recommend maintenance program - tune furnace efficiency, maintain blower fan, seal supply and return ducting, downsize nozzle, check and replace filter if necessary, establish 3 month replacement schedule (USED IN PROGRAM)	replacement nozzle filters maintenance program cost	$ 80 - Tune-up/Maintenance Program
inefficient oil burner	•	oil burner replacement (USED IN PROGRAM)	manufacturer approved oil burner	$ 600 - Total Burner/Solenoid Retrofit
no flue damper	•	install automatic flue damper (USED IN PROGRAM)	manufacturer approved flue damper	$ 450
no solenoid (or clutch coupling system)	•	install solenoid valve (USED IN PROGRAM)	manufacturer approved solenoid valve	$ 75
inefficient pilot light	•	install electrical or mechanical ignition system or install intermittent pilot light or reduce or turn off pilot light in summer (USED IN PROGRAM)	ignition system or intermittent pilot light	Not Applicable to Newfoundland Housing Stock
single set thermostat	•	install night setback thermostat (USED IN PROGRAM)	night setback thermostat	$ 110/thermostat
no circulating pump (hydronic systems)	•	install circulating pump (USED IN PROGRAM)	circulating pump	$ 400
circulating fan temp. high (assume [illegible]°C cut in 65°C cut out temp.)	•	reduce to 32°C (90°F) cut in temp. - 50°C (120°F) cut out temp. (USED IN PROGRAM)		No Cost
ductwork in unconditioned space		insulate ductwork	duct insulating wrap and tape	Homeowner Item approximately $ 70/house
furnace over 20 years old		upgrade new efficient furnace (USED IN PROGRAM)	new heating plant	$ 1400/Hot Air $ 1,800/Hot Water
other options		installation of heat pump	heat pump	$ 4,000/Heat Pump
		installation of head bolt timer	head bolt timer	
	•	installation of head retention kit (USED IN PROGRAM)	head retention kit	$ 600 - Total Burner/Solenoid Replacement

HEATING SYSTEMS (Cont'd)

Existing Condition	Proposed Retrofit	Materials	Contractor Installed Cost
oil furnace	change to electric furnace (USED IN PROGRAM)	electric furnace either forced air or hydronic to coordinate with the existing system	\$ 3,300/Boiler \$ 2,100/Hot Air
electric furnace poorly maintained (hydronic or forced air)	recommend maintenance program seal supply and return ducting (or piping), maintain fan (or pump) change filters as required.	as required	Same as Service Call(Oil Approximately \$ 30
below floor oil space heater (located in uninsulated crawl space)	build insulated wall around heater (insulate floor over crawl space - see insulating measures)	gravel, pressure treated wood framing, 50 mm (2") extruded polystryrene RSI 1.7 (R-10)	\$ 250/Insulated wall \$ 4.30/m^2 - crawl space

COST SUMMARIES

1. INSULATION

RETROFIT		ST. JOHN'S $\$/m^2$	GANDER $\$/m^2$	GOOSE BAY $\$/m^2$
Main & Added Wall	D.I.Y.	N/A	N/A	N/A
	Contr.	10.80	10.80	12.40
Knee Wall	D.I.Y.	4.20	4.20	4.80
	Contr.	8.60	8.60	9.90
Exposed Floor	D.I.Y.	N/A	N/A	N/A
	Contr.	43.60	43.60	50.10
Main & Added Attic	D.I.Y.	N/A	N/A	N/A
	Contr.	* 1.90	* 1.90	* 2.20
Sloped Attic	D.I.Y.	N/A	N/A	N/A
	Contr.	28.00	28.00	32.00
Flat Roof	D.I.Y.	N/A	N/A	N/A
	Contr.	28.00	28.00	32.00
Main & Added Foundation	D.I.Y.	9.70	9.70	11.10
	Contr.	45.80	45.80	52.70
Storm Windows	D.I.Y.	100.00	100.00	115.00
	Contr.	130.00	130.00	150.00
Thermal Doors	D.I.Y.	200.00	200.00	230.00
	Contr.	270.00	310.00	300.00

D.I.Y. - Do-It-Yourself
Contr. - Contractor
N/A - Not Applicable
* - Figure is $\$/m^2$/RSI Thickness

COST SUMMARIES (Cont'd)

NG

RE IT		ST. JOHN'S $/m^2$	GANDER $/m^2$	GOOSE BAY $/m^2$
	D.I.Y. Contr.	7.50 22.50	7.50 22.50	7.50 22.50
	D.I.Y Contr.	10.00 24.00	10.00 24.00	13.00 24.00
	D.I.Y. Contr.	0.20 0.80	0.20 0.80	0.20 0.80

TIC WATER

RE FIT		ST. JOHN'S $/m^2$	GANDER $/m^2$	GOOSE BAY $/m^2$
		30.00	30.00	* 35.00
icti	D.I.Y. Contr.	30.00 60.00	30.00 60.00	30.00 60.00
oil stitution		240.00	240.00	240.00

Not ilable

COST SUMMARIES (Cont'd)

4. FURNACE

RETROFIT		ST. JOHN'S ($)	GANDER ($)	GOOSE BAY ($)
Service		50.00	50.00	50.00
Solenoid Valve		75.00	75.00	75.00
Retention Head		600.00	600.00	600.00
Nozzle Downsizing		10.00	10.00	30.00
New Furnace	Air	1400.00	1400.00	*1900.00
	Water	1800.00	1800.00	
Tuning		30.00	30.00	30.00
Circulating Pump		300.00	300.00	300.00
Automatic Thermostat		100.00	110.00	130.00

* Average Cost of Both

COST SUMMARIES (Cont'd)

5. WOOD HEAT

RETROFIT		ST. JOHN'S ($)	GANDER ($)	GOOSE BAY ($)
New (Inst/Unit)	<30 l	40/600	40/600	50/700
Stove	30-90 l	40/700	40/700	50/800
From Smallest	90-135 l	50/900	50/900	60/1000
Box size (litres)	>135 l	60/1100	60/1100	70/1300
Warm Air (Inst/Unit)	<15 kW	400/900	400/900	460/1000
Furnace	15-20 kW	400/1800	400/1800	460/2100
From 15 kW	20-30 kW	400/1800	400/1800	400/2100
to 30 kW	>30 kW	400/1800	400/1800	460/2100
		400/1800	400/1800	
Hydronic (Inst/Unit)	<15 kW	400/1500	400/1500	460/1800
Furnace	15-20 kW	400/1500	400/1500	460/1800
	20-30 kW	400/2500	400/2500	460/2900
	>30 kW	400/2800	400/2800	460/3200
Chimney (per metric length)		100	100	115

Inst - Installation Cost

Unit - Unit Cost

COST SUMMARIES (Cont'd)

6. ELECTRIC HEAT - LABRADOR

RETROFIT		COST
Electric	<15 kW	1600/430
Warm Air	15-20 KW	1600/450
	20-30 kW	1600/500
	>30 kW	1600/1000
(Inst/Unit)		
Electric	<15 kW	1800/700
Hydronic	15-20 kW	1800/720
	20-30 kW	1800/850
	>30 kW	1800/1500
(Inst/Unit)		

Appendix V-B

Data Forms

Appendix V-C

Program Update

REGIONAL VARIATIONS - ST. JOHN'S, GANDER AND GOOSE BAY

The regional and seasonal contants are unfortunately not yet in any "quick and easy" to change format. They have been discussed in detail in this and other documents. The following table is meant to serve as an index to facilitate making changes.

PROGRAM	LINE(S)	CONSTANT
AUDIT	70 - 80	Advisor's initials
	100 - 120	Telephone exchanges
	410	Area Code
	760	Province
	10890	Year
CRUNCH	160 - 170	D.H.W. Standby Costs
	1440	Cost of 1 1 oil last season
	1520	Degree days/season
	1534	Fuel Factors
	1710	Cost of 1 1 oil last season
	1780	Cumulative degree day file
	2070	Degree days/season
	2290	D.H.W. Replacement Costs
	2500	Inflation rates
	2680 - 2780	Insulating Costs
	2680 - 2780	Optimum RSI's
	3180 - 3185	D.H.W. insulation costs
	3210,3240,3260	D.H.W. insulation savings
	3330	Flow restrictor costs
	3510	Winter day temp.
	3520	Winter night temp.
	3580	Thermostat setback cost
	5080	Window Sealing Cost
	5220	Door sealing cost
	5490	Envelope sealing cost
CRUNCH2	80	Table of available nozzles

REGIONAL VARIATIONS - ST. JOHN'S, GANDER AND GOOSE BAY (Cont'd)

PROGRAM	LINE(S)	CONSTANT
	200	Design Temp.
	210	Design temp.
	950	Design temp.
	1140	Design temp.
	1370	Service call cost
	1400	Solenoid cost
	1430	Ret. head cost
	1480	Nozzle cost
	1530	Furnace cost
	1580	Tuning cost
	1620	Circ. Pump cost
	3040	Chimney cost/meter
	3090	Design temp.
	3250-3260	Wood central heating costs
	3310	Wood stove costs
	3330	Wood stove costs
	3340	Wood stove costs
	4000	Cost D.H.W. coil
	5080	Electric Furnace Unit Cost (Labrador Only)
	5136	Electric Boiler Unit Cost (Labrador Only)

PROGRAM UPDATE

DATE: 1982 11 27

PROGRAM: Crunch

ADDITION: Upgraded Basement, Wall and Attic Sealing Subroutine

```
5400 'SEALING -- BASEMENT, WALLS, & ATTIC

5410 'INFILTRATION RESPONSES - 0=REQUIRES   0% SEAL
                               1=          50%
                               2=         100%

5415 TOTAL(1)=0 : TOTAL(2)=0 : N=0

5416 FOR Q%=320 TO 362 STEP 2:CHEK$(Q%)=ANSWER$(Q%):NEXT Q%:
     IF CHEK$(320)="0" THEN 5422 ELSE 5417

5417 IF CHEK$(322)="0" THEN 5422 ELSE 5418

5418 IF CHEK$(340) ="0" THEN 5422 ELSE 5419

5419 IF CHEK$(342)  ="0" THEN 5422 ELSE 5420

5420 IF CHEK$(360)  ="0" THEN 5422 ELSE 5421

5421 IF CHEK$(362)  ="0" THEN 5422 ELSE 5430

5422 AREA(1) = SUBAREA(9) + SUBAREA(10)

5423 IF L%=1 THEN I= VAL(ANSWER$(271)

5424 P=I*.5 : N=N+P:
     TOTAL(2) = TOTAL(2)+P*AREA(1)

5425 GOTO 5480

5430 AREA(1)=SUBAREA(9)+SUBAREA(10) :
     AREA(2)=SUBAREA(1)+SUBAREA(2)+SUBAREA(3) :
     AREA(3)=SUBAREA(5)+SUBAREA(6)+SUBAREA(7)+SUBAREA(4)+
             SUBAREA(8)

5440 FOR L%=1 TO 3

5450 I=VAL(ANSWER$(270+L%))

5460 P=I*.5 : N=N+P :
     TOTAL(1)=TOTAL(1)+AREA(L%) :
     TOTAL(2)=TOTAL(2)+P*AREA(L%)

5470 NEXT L%

5480 IF N=0 THEN 5521 :'NO NEED

5490 DCOST=.2 : PCOST=4*DCOST :
        SAVED=.1*N

5500 SAVINGS(23)=SAVED*CON*ACLOSS/HTNGLOAD
```

PROGRAM UPDATE (CONT'D)

WALL SEALING SUBROUTINE

```
5510 DIYCOST(23)=DCOST*TOTAL(2) :
     PROCOST(23)=PCOST*TOTAL(2)

5520 DIYPBACK(23)=DIYCOST(23)/SAVINGS(23) :
     PROPBACK(23)=PROCOST(23)/SAVINGS(23)

5521 '

5524 FOR Q%=320 TO 362 STEP 2:CHEK$(Q%)=ANSWER$(Q%):NEXT Q%:
     IF CHEK$(320) ="0" THEN 5530 ELSE 5525

5525 IF CHEK$(322) ="0" THEN 5530 ELSE 5526

5526 IF CHEK$(340) ="0" THEN 5530 ELSE 5527

5527 IF CHEK$(342) ="0" THEN 5530 ELSE 5528

5528 IF CHEK$(360) ="0" THEN 5530 ELSE 5529

5529 IF CHEK$(362) ="0" THEN 5530 ELSE 5600

5530 TOTAL(1)=0 :N=0

5533 AREA(1) = SUBAREA(1)+SUBAREA(2)+SUBAREA(3):
     AREA(2) = SUBAREA(5)+SUBAREA(6)+SUBAREA(7)+
               SUBAREA(8)+SUBAREA(4)

5534 FOR L%=1 TO 2 :I=2

5535 P=I*.5 : N=N+P :
     TOTAL(1)=TOTAL(1) + P*AREA(L%):NEXT L%

5537 SAVED =.1*N

5538 WALLSAVINGS=SAVED*CON*ACLOSS/HTNGLOAD

5539 FOR L%= 1 TO 3

5540 WALLSAVINGS= .6*WALLSAVINGS

5541 IF RSI(L%)>(.7*OPTRSI(L%)) THEN 5548

5542 SAVINGS(L%) = SAVINGS(L%) + WALLSAVINGS

5544 PROCOST(L%) = SUBAREA(L%)*PCOST(L%)

5546 PROPBACK(L%)=PROCOST(L%)/SAVINGS(L%)

5548 NEXT L%

5600 LABEL$(21)="WINDOW WEATHERSTRIP" :
     LABEL$(22)="DOOR WEATHERSTRIP" :
     LABEL$(23)="ENVELOPE CAULKING"
```

WALL SEALING SUBROUTINE

EXPLANATION

This subroutine calculate the savings due to the caulking of the walls at the ceiling and the floor when the walls are insulated. It adds the savings to the wall insulation saving and recalculates the overall wall savings. If the wall is not insulated the savings subroutine defaults to the original procedure.

PROGRAM UPDATE

DATE: 1982 10 25

PROGRAM: Crunch (St. John's, Gander, Goose Bay)

ADDITION: Line 3450

Addition of word automatic for label $ (41)

EXPLANATION

The addition of the word automatic flags the advisor to explain the automatic setback thermostat recommendation.

PROGRAM UPDATE

DATE: 1982 10 25

PROGRAM: Audit (St. John's, Gander, Goose Bay)

CHANGE: Lines 1200 to 1490, 2000 to 2055

```
1200 '*************************************************
1210 'SECTION 15 — DIMENSIONS & INSULATION
1220 FOR SECTOR%=15 TO 25 :
          READ SECTION$(SECTOR%) :
          NEXT SECTOR%
1230 DATA MAIN WALL,ADDED WALL,KNEE WALL
1240 DATA EXPOSED FLOOR,MAIN ATTIC,ADDED ATTIC
1250 DATA SLOPED ATTIC,FLAT ROOF,FOUNDATION,ADDED FOUNDATION
1260 DATA BASEMENT FLOOR
1270 KON%=290 : Q.IN.SECT%=2
1280 FOR SECTOR%=15 TO 25 :
          KON%=KON%+20
1490 IF SECTOR%=25 THEN 1920 :'BSMNT FLOOR NO INSULATION

 2000 'FOUNDATION HEIGHT ABOVE GRADE/INSULATION DEPTH
                                    DATUM 520-523
 2010 SECTOR%=25 : FIRST.Q.IN.SECT%=520 :
          Q.IN.SECT%=4 : GOSUB 12000
 2020 DATA FOUNDATION WALL HEIGHT ABOVE GRADE
 2021 DATA FOUNDATION WALL DEPTH OF INSULATION
 2022 DATA ADDED FOUNDATION WALL HEIGHT ABOVE GRADE
 2023 DATA ADDED FOUNDATION WALL DEPTH OF INSULATION
 2030 SECTION$(SECTOR%)="FOUNDATION HEAT LOSS"
 2040 GOSUB 11900 :'BUMP QUESTION
 2050 IF QUESTION%=520 AND ANSWER$(470)="" THEN QUESTION%=522
 2055 IF QUESTION%=522 AND ANSWER$(490)="" THEN 2090
```

Changes are underlined

EXPLANATION

The program now has an extra section for flat roof descriptions and thus all input below it (input 470) are bumped by 10.

PROGRAM UPDATE

E: 1982 10 25

GRAM: Crunch (St. John's, Gander, Goose Bay)

NGE: Line 330

e 330 for L% = 310 to 510 STEP 20

nges a nderlined

LANATIO

s allow or flat roof addition to program

PROGRAM UPDATE

DATE: 1982 10 25

PROGRAM: Crunch

CHANGE: Lines 810 to 870; 930 to 945

```
810 '
812 BSMTTMP%=VAL(ANSWER$(36)) :
    HTABVGRD(9)=VAL(ANSWER$(520))/10 :
    HTABVGRD(10)=VAL(ANSWER$(522))/10
815 PRINT "THINKING 815"
820 'NOW SUBAREAS
       DERIVE RSI OF EACH
830 'ASSUMED RSI/MM  1-BATTS(1.55/89)
                     2-LOOSE(1.55/89)
                     3-BOARD(.031)
840 L%=300
841 'BASEMENT FLOOR OR SLAB RSI VALUE
842 IF ANSWER$(26)="3" THEN RSI(11)=4
                       ELSE RSI(11)=7
843 IF BSMTTMP%<=15 AND ANSWER$(26)="1"
                       THEN RSI(11)=100
850 FOR LC%=1 TO 11 : L%=L%+20 :
       IF SUBAREA(LC%)=0 THEN 999
855 IF LC%<9 THEN RSI(LC%)=.7 :'BASE VALUE UNINSULATED AREA
857 IF LC%=3 OR LC%=5 OR LC%=6
       THEN RSI(LC%)=.2
870 IF LC%=11 THEN 940
930 NEXT M%
935 IF LC%=9 OR LC%=10 THEN 942
940 IF RSI(LC%)>0 THEN
       CONDLOSS=CONDLOSS+SUBAREA(LC%)/RSI(LC%)
941 GOTO 999
942 'CONDUCTIVE LOSSES THROUGH BASEMENT WALL
943 IF RSI(LC%)>0 THEN 945
944 KO(LC%)=1 : GOTO 948 :'KO()=1=UNINSULATED WALL
945 IF (LC%=9 AND VAL(ANSWER$(521))=
       VAL(ANSWER$(471))) OR (LC%=10  AND VAL(ANSWER$(523))=VAL(ANSWER$(49
       THEN 947
```

Changes are underlined

EXPLANATION

This portion of Crunch must be updated to include the flat roof option.

PROGRAM UPDATE

DATE: 1982 10 25

PROGRAM: Crunch (St. John's, Gander, Goose Bay)

CHANGE: Lines 2650, 2660, 2791 - 2880

```
  2650 M%=0 : RSI(12)=.15 : RSI(13)=.5
  2660 FOR L%=1 TO 13 :
       IF L%=11 THEN 2940 :'SKIP BASEMENT FLOOR
  2791 IF L%<9 OR L%>10 THEN 2800
  2792 IF KO(L%)=3 THEN 2940
  2793 'SAVINGS FOR FOUNDATION
  2794 SAVINGS(M%)=(CLOSS(M%-2)-CLOSS(M%))*CON/HTNGLOAD
  2795 IF KO(L%)=1 THEN 2820
  2796 KO=SUBAREA(L%)  :  SUBAREA(L%)=SUBAREA(L%)*
            (VAL(ANSWER$(521+((L%-9)*2)))/
             VAL(ANSWER$(471+((L%-9)*20)))) :
  'THE ABOVE CALCS AREA OF UNINSULATED WALL
  2797 GOTO 2820
  2800 IF RSI(L%)>(.7*OPTRSI(M%)) THEN 2940:'NEXT L%
  2810 SAVINGS(M%)=CON*SUBAREA(L%)/
            RSI(L%)/HTNGLOAD*(1
            -RSI(L%)/OPTRSI(M%))
  2820 ON L% GOTO 2840,2840,2840,2890,2890,2890,2840,
            2840,2840,2840,2840,2840,2840
  2830 'WALLS AND SLOPED ATTIC
  2840 DIYCOST(M%)=SUBAREA(L%)*DCOST(M%)
  2850 PROCOST(M%)=SUBAREA(L%)*PCOST(M%)
  2860 IF DCOST(M%)>0 THEN DIYPBACK(M%)
            =DIYCOST(M%)/SAVINGS(M%)
  2870 PROFBACK(M%)=PROCOST(M%)/SAVINGS(M%)
  2880 IF L%<9 OR L%>10 THEN 2940
```

Changes are underlined

EXPLANATION

Because of flat roof addition the numbering system must be increased by 1 throughout saving's calculation

PROGRAM UPDATE

DATE: 1982 10 25

PROGRAM: Crunch (St. John's, Gander, Goose Bay)

CHANGE: Lines 3020, 3070, 3275 - 3299

```
 3020 LABEL$(61)="TANK INSULATION" :
      LABEL$(62)="TEMPERATURE SETTING" :
      LABEL$(63)="FLOW RESTRICTORS":
      LABEL$(64)="TANKLESS COIL IN SUMMER"
 3070 IF ANSWER$(600)="1" THEN 3275 : 'CONVERT TO ELECTRIC
        HOT WATER IF TANKLESS COIL
[3275 RRF =.003*DHWUSED%*90: SSF =25 - 9          ]
[3277 SAVINGS(64)=RRF + SSF                       ] ADDITION
[3279 PROCOST(64)= 240                            ]
[3299 PROFBACK(64) = PROCOST(64)/SAVINGS(64)      ]
```

Changes are underlined, additions are bracketed

EXPLANATION

The program now substitutes a self-contained DHW system for tankless coil in summer

RRF = RCF of original program

SSF = SCF of original program

240 is the installed cost of an electric tank costs are based on electric substitution.

PROGRAM UPDATE

DATE: 1982 10 25

PROGRAM: Crunch (St. John's, Gander, Goose Bay)

CHANGE: Lines 1880, 2020

Line 1880 `DEGDAY 1 = CVD (DEGDAY$)`

Line 2020 `DEGDAY 2 = CVD (DEGDAY$)`

Change is that division by 10 is eliminated

EXPLANATION

New degree day files are actual numbers from weather office. Therefore, division by 10 to make them actual data is no longer required by this version. (Old version uses 10 x Degree Days)

PROGRAM UPDATE

DATE: 1982 10 25

PROGRAM: Auditout (Goose Bay)

ADDITION: Lines 2705 - 2996 Electric Heat Substitution

```
2705 IF ANSWERS$(70)="3" THEN GOTO 3200
~~2710 FOR L%=2 TO 0 STEP -1~~
2715 IF L%=0 THEN 2850
2720 PRINT CHR$(&H1A):
     ~~T$="ELECTRIC HEAT SUBSTITUTION ENERGY CONSERVATION"~~
2730 IF L%=2 THEN T$=T$+" CARRIED OUT" ELSE
                  T$=T$+" NOT CARRIED OUT"
~~2735 PRINT T$~~
2740 U$="ELECTRIC FURNACE OR BOILER"
2750 T$=U$+" SIZE ### KW":
     ~~PRINT USING T$;PEAKHEATKW(L%)~~
2755 V$="FURNACE":W$="BOILER"
2760 T$="COSTS "+V$+" $$####   "+W$+" $$####":
     ~~PRINT USING T$;EUNIT(L%,1),EUNIT(L%,2)~~
2770 T$="INSTALLATION  $$####            $$####":
     PRINT USING T$;EINST(L%,1),EINST(L%,2)
~~2780 PRINT TAB(16);"_____",TAB(32);"_____"~~
2790 T$="          TOTAL $$####            $$####":
     T1=EUNIT(L%,1) + EINST(L%,1):
     ~~T2=EUNIT(L%,2) + EINST(L%,2)~~
2800 PRINT USING T$;T1,T2
2810 PRINT:
     ~~INPUT "PRESS RETURN TO PROCEED";T$~~
2850 'SECOND DISPLAY :PRINT CHR$(&H1A)
2855 IF L%=0 THEN PRINT CHR$(&H1A) "PRECEEDING TABLES COMBINED"
~~2860 T$="SAVING AND PAYBACK SUMMARY":PRINT T$~~
2870 T$="SAVING      PAYBACK     PAYBACK":PRINT T$
2880 T$="            FURNACE     BOILER":PRINT T$
~~2890 T$="$$####      ##.#        ##.#"~~
2900 IF L%=0 THEN 2940
2910 PRINT USING T$;ESAVING(L%,1),EPYBKFU(L%,1),EPYBKFU(L%.2)
~~2920 PRINT:~~
     INPUT "PRESS RETURN TO PROCEED";T$
2930 NEXT L%: PRINT CHR$(&H1A)
~~2940 'COMBINED DISPLAY HEADING ALREADY DONE~~
2950 FOR L%=2 TO 1 STEP -1
2960 PRINT USING T$;ESAVING(L%,1),EPYBKFU(L%,1),EPYBKFU(L%,2):NEXT L%
~~2970 PRINT CHR$(&H1B)~~
2980 T$="AFTER CONSERVATION RETROFITS":PRINT T$
2990 T$="FURNACE RATING KW ### BOILER RATING KW ###":
     ~~PRINT USING T$;PEAKHEATKW(2),PEAKHEATKW(2)~~
2992 PRINT CHR$(&H1B): T$="BEFORE CONSERVATION RETROFITS":PRINT T$
2994 T$="FURNACE RATING KW ### BOILER RATING KW ###":
     ~~PRINT USING T$;PEAKHEATKW(1),PEAKHEATKW(1)~~
2996 GOSUB 1730:GOTO 3200
```

EXPLANATION

Output of electric heat substitution routine.

PROGRAM UPDATE

DATE: 1982 10 25

PROGRAM: Crunch 2 (Goose Bay)

ADDITION: Electric Substitution Routine

```
~~5000 'ELECTRIC SUBSTITUTION ROUTINE~~
5002 IF ANSWERS(70)="3" THEN 6000
5005 FLAG=1
~~5010 PEAKHEATKW(FLAG)=(HTNGLOAD*(AVGTMP+31))/1000~~
5030 DIM ECOST(1,4,2)
5035 DIM BCOST(1,4,2)
~~5040 'ARRAY OF COST=~~
     ACROSS 1) FURNACE
     DOWN 4 PEAKHEATKW >30 TO <15
     ~~BACK 1)INSTALLATION COST 2) UNIT COST~~
5050
     FOR DN=1 TO 4 :
     ~~FOR BK=1 TO 2~~
5060 READ ECOST(1,DN,BK)
5070 NEXT BK:NEXT DN
~~5080 DATA 1600,430,1600,450,1600,500,1600,1000~~
5100 DN = CINT((PEAKHEATKW(FLAG)*1)/10 +.5)
5110 IF DN>4 THEN DN=4
~~5120 EINST (FLAG,1)=ECOST(1,DN,1):~~
     EUNIT (FLAG,1)=ECOST(1,DN,2)
5130 THCOST(FLAG,1)= EINST(FLAG,1)+ EUNIT(FLAG,1):IF FLAG=2 GOTO 5137
~~5132 'ARRAY OF COST=~~
     ACROSS 1) BOILER
     DOWN 4 PEAKHEATKW >30 TO <15
     ~~BACK 1)INSTALLATION COST 2) UNIT COST~~
5133
     FOR DN=1 TO 4:
     ~~FOR BK=1 TO 2~~
5134 READ BCOST(1,DN,BK)
5135 NEXT BK:NEXT DN
~~5136 DATA 1800,700,1800,720,1800,850,1800,1300~~
5137 DN = CINT((PEAKHEATKW(FLAG)*1)/10 +.5)
5138 IF DN>4 THEN DN=4
~~5139 EINST (FLAG,2)=BCOST(1,DN,1):~~
     EUNIT (FLAG,2)=BCOST(1,DN,2)
5150 THCOST(FLAG,2)= EINST(FLAG,2)+ EUNIT(FLAG,2)
~~5155 'THE FACTOR .64 IS THE FRACTIONAL COST~~
      THAT ELECTRICITY IS OF OIL IN LABRADOR
5160 ESAVING(FLAG,1)=OILHTCOST(FLAG)-.64*OILHTCOST(FLAG)
~~5165 ESAVING(FLAG,2)=OILHTCOST(FLAG)-.64*OILHTCOST(FLAG)~~
5170 EPYBKFU(FLAG,1)= THCOST(FLAG,1)/ESAVING(FLAG,1)
5175 EPYBKFU(FLAG,2)= THCOST(FLAG,2)/ESAVING(FLAG,2)
~~5179 IF FLAG=2 THEN 6000~~
5180 FLAG=2:'THIS PART CALCULATES THE SAVINGS AFTER
     RETROFITS CARRIED OUT
~~5185 HTREDFTR=(1-SAVENV/SPCHTCOST)~~
5190 PEAKHEATKW(FLAG)=PEAKHEATKW(1)*HTREDFTR~~:GOTO 5100~~
5195 OILHTCOST(2)=OILHTCOST(1)*HTREDFTR:goto 5100
~~6000 CHAIN MERGE "B:AUDITOUT.HV1",,ALL,DELETE 10-6000~~
```

EXPLANATION (Continued on next page)

PROGRAM UPDATE (Cont'd)

EXPLANATION

- This subroutine is automatically accessed if the house is not electrical already.
- The recommendation is for an electric furnace or boiler and displays both.
- It shows the furnace/boiler size before and after retrofits.
- The cost of conversion includes electric rewiring of house as required by Newfoundland and Labrador Hydro.

PROGRAM UPDATE

DATE: 1982 10 25

PROGRAM: Crunch 2 (Goose Bay)

ADDITIONS AND CHANGES TO WOOD ROUTINE:

Lines 2135, 2140, 3000, 3010

```
2135 IF ANSWER$(70)="3" THEN 3000
2140 IF ANSWER$(70)<>"1" THEN 6000

3000 'WOOD ROUTINE
3010 IF ANSWER$(105)="0" THEN 5000 :SKIP ROUTINE
```

Changes are underlined

EXPLANATION

Line 2135 allows access to wood routine if electrically heated.
Line 2140 skips to end of crunch 2 if not oil or electrical.
Line 3010 skips to electric substitution subroutine
The advisor should input 1 as an answer to question 105 wood routine access because of currently unsolved bug in program. Therefore the wood and electric subroutine will be accessed sequentially whether the homeowner requires it or not.

PROGRAM UPDATE

DATE: 1982 10 25

PROGRAM: Crunch (Goose Bay)

CHANGE: Lines 1780 - 2800

```
 1780 OPEN "R",#2,"LABDAYC.DAT",8
~~1790 FIELD #2,8 AS DEGDAY$~~
 1800 '
 1810 'START OIL RECORDS - FIRST IS REF FOR DEG DAYS
~~1820 DATE$(1)="760101"~~
 1830 DATE$(2)=ANSWER$(73) : GOSUB 10309
 1840 REC%=DAY.YEAR%(2) : IF NUM.YEAR%(2)=80
~~          THEN REC%=REC%-258 ELSE~~
          IF NUM.YEAR%(2)=82 THEN REC%=REC%+367
 1850 IF NUM.YEAR%(2)=81 AND DAY.YEAR%(2)<106
~~          THEN REC%=REC%+108~~
 1860 IF NUM.YEAR%(2)=81 AND DAY.YEAR%(2)>257
          THEN REC%=REC%+2
~~1870 GET #2,REC%~~
 1880 DEGDAY1=CVD(DEGDAY$)
 1950 '
~~1955 PRINT "THINKING 1955"~~
 1960 'SECOND (TO ALL) RECORD
 1962 FOR L%=76 TO 94 STEP 3 :
~~        IF ANSWER$(L%)="" THEN 1975~~
 1966 OILUSED=OILUSED+VAL(ANSWER$(L%+1)) :
        DOLLARS=DOLLARS+VAL(ANSWER$(L%+2))
~~1968 NEXT L%~~
 1975 L%=L%-3 : DATE$(2)=ANSWER$(L%) : GOSUB 10309
 1980 REC%=DAY.YEAR%(2) : IF NUM.YEAR%(2)=80
~~          THEN REC%=REC%-258 ELSE~~
          IF NUM.YEAR%(2)=82 THEN REC%=REC%+367
 1990 IF NUM.YEAR%(2)=81 AND DAY.YEAR%(2)<106
~~          THEN REC%=REC%+108~~
 2000 IF NUM.YEAR%(2)=81 AND DAY.YEAR%(2)>257
          THEN REC%=REC%+2
```

Changes are underlined

EXPLANATION

This accesses new Labrador degree day file (LABDAYC.DAT) which has been lengthened from September 15 to May 31.

PROGRAM UPDATE

DATE: 1982 10 25

PROGRAM: Auditout (St. John's, Gander, Goose Bay)

CHANGES: Lines 650 to 671, 712 to 716

```
 650 PRINT T$;
 660 IF M%>=11 THEN 740
 661 'INSULATION RECOMMENDATION
 665 IF M%=10 THEN 712
 667 IF M%=9  THEN 712
 668 IF M%=8  THEN 715
 670 'INSULATION RECOMMENDATION
 671 IF M%>7    THEN 712
 712 T$="ADD 89 MM BATT TO UNINSULATED WALL AREA"
 713 PRINT T$:GOTO 1600
[715 T$="ADD 150 MM RIGID INSULATION INVERTED ROOF SYSTEM"]
 716 PRINT T$                                             ]
```

Changes are underlined, additions are bracketed.

EXPLANATION

This allows for the flat roof recommendation to be outputted to screen.

PROGRAM UPDATE

DATE: 1982 10 25

PROGRAM: Crunch 2 (St. John's, Gander, Goose Bay)

ADDITION: Lines 4010 and 4020

```
4010     If WDHW saving   =  0 then WDHW saving = 0
4020     If WDHW saving   =  0 then WDHW payback = 20
```

EXPLANATION

This sets the wood domestic hot water savings to be zero and payback to be 20 years if the savings are less than or equal to zero.

PROGRAM UPDATE

DATE: 1982 10 25

PROGRAM: Crunch 2 (St. John's, Gander, Goose Bay)

ADDITION: Line 2135

```
2135     If answer $ (70) = "3" then 3000
```

EXPLANATION

This allows the program to access the wood heat subroute if the house is electrically heated. It provides the homeowner with the wood stove information and number of cords of wood to be burned.

PROGRAM UPDATE

DATE: 1982 10 25

PROGRAM: Auditout (St. John's, Gander, Goose Bay)

ADDITIONS: Lines 1481 and 1482

```
1481 T$ = "CONVERT TO SELF-CONTAINED HOT WATER TANK IN SUMMER"
1482 PRINT T$ :GOTO 1600
```

EXPLANATION

Output for tankless coil substitution recommendations.

Appendix V-D

Updates to ENERPLAN Advisor's Input Manual

CATEGORY: CONTACT INPUT NO: (4)

COMPUTER PROMPT: AREA CODE

DATA FORM FORMAT: ☐☐☐
CODE

ADVISOR QUESTION:

RESPONSE RANGE:

PRE-ENTERED FOR NFLD.

DESCRIPTION:

QUESTION IS NOT ASKED AT THIS TIME.

AREA CODE IS PRE-ENTERED.

PROGRAM USE: NOT USED

MILLBANK REFERENCE: QUESTION (5) NO CHANGE

CATEGORY: CONTACT INPUT NO: (5)

COMPUTER PROMPT: TELEPHONE NUMBER

DATA FORM FORMAT: $ ☐☐☐☐☐☐☐
TELEPHONE

ADVISOR QUESTION:

RESPONSE RANGE:

ALL 7 DIGITS OF PHONE NUMBER.

ONLY VALID ST. JOHN'S, GANDER OR GOOSE BAY

DESCRIPTION:

TELEPHONE NUMBER OF INTERVIEWEE TO BE ENTERED ON FORM BY DISPATCHER. IT IS IMPORTANT TO GET CORRECT NUMBER, AS IT WILL BE USED FOR LATER COMMUNICATION.

EDIT: Previous input no's 1, 2, 3 & 5 and questions on screen in dim writing. Entered values in bright writing.

MESSAGE: verify (type number to change/return to proceed)

PROGRAM USE: NOT USED

MILLBANK REFERENCE: QUESTION (5) NO CHANGE

CATEGORY: ADDRESS INPUT NO: (9)

COMPUTER PROMPT: PROVINCE

DATA FORM FORMAT: ☐☐
PROVINCE

ADVISOR QUESTION:

RESPONSE RANGE: NONE

DESCRIPTION:

QUESTION NOT ASKED, "NFLD" IN MEMORY

PROGRAM USE: NOT USED

MILLBANK REFERENCE: NOT ASKED

CATEGORY: ADDRESS

INPUT NO: (13)

COMPUTER PROMPT: PROVINCE

DATA FORM FORMAT: 13 ☐☐☐
PROVINCE

ADVISOR QUESTION:

RESPONSE RANGE:

QUESTION IS NOT ASKED.

NFLD IS INPUT IN COMPUTER MEMORY.

DESCRIPTION:

TO BE ENTERED ON FORM BY DISPATCHER

PROGRAM USE: NOT USED

MILLBANK REFERENCE: NOT ASKED

CATEGORY: ADDRESS INPUT NO: (14)

COMPUTER PROMPT: METER NUMBER

DATA FORM FORMAT: 14 ☐☐☐☐☐☐ ☐☐☐
Meter Number

ADVISOR QUESTION:

RESPONSE RANGE:

6 CHARACTERS SPACE 3 CHARACTERS

DESCRIPTION:

METER NUMBER IS THE ELECTRIC METER NUMBER OF THE RESIDENCE.

TO BE ENTERED ON FORM BY DISPATCHER, ALL 9 DIGITS MUST BE ENTERED.

PROGRAM USE: THE METER NUMBER IS THE KEY REFERENCE NUMBER FOR THIS FILE. USE OF THIS NUMBER ALSO PERMITS CROSS-REFERENCE WITH EMR COSP FILES WHICH ARE INDEXED WITH SAME NUMBER.

MILLBANK REFERENCE: NOT ASKED

CATEGORY: IDENTIFICATION INPUT NO: (21)

COMPUTER PROMPT: TYPE OF HOME

DATA FORM FORMAT: 21 ☐
TYPE

ADVISOR QUESTION:

RESPONSE RANGE:
1 - DETACHED
2 - SEMI-DETACHED
3 - ROW
4 - MOBILE

DESCRIPTION:
DETACHED - single family home
SEMI-DETACHED - two homes sharing 1 wall in common
ROW - homes with 2 walls in common
MOBILE - prefabricated movable home
NOTE: DO NOT REFER TO HOME AS TRAILER.
USE MOBILE HOME.

PROGRAM USE: NOT USED

MILLBANK REFERENCE: QUESTION (7). ANSWERS: single, semi-detached, duplex, triplex, row. Duplex and triplex were omitted (not found on NFLD.). Mobile home was added (common on NFLD. - 6% of housing stock).

CATEGORY: IDENTIFICATION INPUT NO: (26)

COMPUTER PROMPT: TYPE OF FOUNDATION

DATA FORM FORMAT: 26 ☐ FOUNDATION

ADVISOR QUESTION: DO YOU HAVE A FULL BASEMENT UNDER THIS HOUSE?

RESPONSE RANGE: 1 - full basement
2 - crawl space
3 - slab on grade
4 - post or piers
5 - combination (crawl space and full basement)

DESCRIPTION:

PROGRAM USE: RESPONSE 1 AND 3 USED IN DETERMINING SLAB HEAT LOSS

MILLBANK REFERENCE: QUESTION (11). TWO ANSWERS WERE ADDED IN ADS PROCEDURE: (4) COMBINATION OF CRAWL SPACE AND FULL BASEMENT; (5) POST OR PIERS.

CATEGORY: ELECTRICITY INPUT NO: (108)

COMPUTER PROMPT: METER FOR HOME ONLY?

DATA FORM FORMAT: 108 ☐ HOME

ADVISOR QUESTION: IS YOUR METER FOR YOUR HOME ELECTRICAL USE ONLY?

RESPONSE RANGE:

0 - NO

1 - YES

DESCRIPTION:

IF ELECTRIC BILL COVERS HOME USAGE ONLY, THEN ENTER "1".

IF ELECTRIC BILL COVERS HOME USAGE PLUS ANY OTHER SOURCE OF CONSUMPTION SUCH AS OFFICES OR OUT BUILDINGS, ENTER "0".

ELECTRICAL DATA CAN BE USED TO ANALYSE RESIDENTIAL ELECTRICAL CONSUMPTION FOR STATISTICAL PURPOSES.

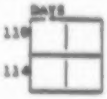
PROGRAM USE: USED IN NEW FREE HEAT SUB-ROUTINE

MILLBANK REFERENCE: NOT ASKED

CATEGORY: ELECTRICITY INPUT NO: 110, 114

COMPUTER PROMPT: DAYS

DATA FORM FORMAT:



ADVISOR QUESTION:

RESPONSE RANGE:

01 - 99

DESCRIPTION:

ENTER THE NUMBER OF DAYS COVERED IN THE BILLING PERIOD AS FOUND ON THE HOME OWNER'S ELECTRIC BILL. USE SUMMER MONTH IF POSSIBLE FROM JUNE TO SEPTEMBER.

IF ELECTRIC BILLS ARE NOT AVAILABLE, PRESS RETURN TO CONTINUE ON TO NEXT SECTION.

IF RESPONSE TO QUESTION (108) IS "0" THEN QUESTIONS 110 - 117 ARE NOT ASKED.

PROGRAM USE: USED IN NEW FREE HEAT SUB-ROUTINE

MILLBANK REFERENCE: NOT ASKED

CATEGORY: ELECTRICITY

INPUT NO: 111, 115

COMPUTER PROMPT: DATE

DATA FORM FORMAT:

	YEAR		MONTH		DAY	
111						
115						

ADVISOR QUESTION:

RESPONSE RANGE:

DAY	01 - 31
MONTH	NUMERICAL 01 - 12
YEAR	LAST TWO DIGITS ONLY 81 OR 82

DESCRIPTION:

ENTER DATE AS FOUND ON THE ELECTRICAL BILL.

PROGRAM USE: USED IN NEW FREE HEAT SUB-ROUTINE

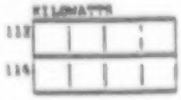
MILLBANK REFERENCE: NOT ASKED

CATEGORY: ELECTRICITY

INPUT NO: 112, 116

COMPUTER PROMPT: KWH

DATA FORM FORMAT:



ADVISOR QUESTION:

RESPONSE RANGE:

0001 - 9999

DESCRIPTION:

ENTER NUMBER OF KILOWATT HOURS USED DURING BILLING PERIOD.

PROGRAM USE: USED IN NEW FREE HEAT SUB-ROUTINE

MILLBANK REFERENCE: NOT ASKED

CATEGORY: THERMOSTAT INPUT NO: 282

COMPUTER PROMPT: AUTOMATIC SET-BACK DEVICE

DATA FORM FORMAT: 282 ☐ AUTO.

ADVISOR QUESTION:

RESPONSE RANGE:

0 - NO
1 - YES

DESCRIPTION:

IS THE HOUSE OCCUPIED DURING THE DAYTIME? (FROM 8 A.M. TO 4 P.M.)?

REPEAT FOR ALL THERMOSTATS.

PROGRAM USE: USED FOR SET-BACK DEVICE RECOMMENDATION

MILLBANK REFERENCE: QUESTION 136 CHANGED TO CALCULATE SAVINGS WITH OR WITHOUT AUTOMATIC SETBACK T'STAT

CATEGORY: LIVING SPACE, ATTIC, FOUNDATION INPUT NO:321- 503

COMPUTER PROMPT: EXISTING INSULATION THICKNESS

DATA FORM FORMAT:

	THICKNESS		
321			
322			

ADVISOR QUESTION: WHAT IS THE AMOUNT OF INSULATION IN THE WALLS?

RESPONSE RANGE:

001 - 999

DESCRIPTION:

THE EXISTING INSULATION THICKNESS IS THE THICKNESS OF THE INSULATION IN THE WALL CAVITY. THIS INFORMATION IS OBTAINED FROM A VISUAL INSPECTION BEHIND ELECTRICAL OUTLETS.

INSULATION THICKNESS IS RECORDED IN MILLIMETERS.

PROGRAM USE: HEAT LOSS CALCULATIONS

MILLBANK REFERENCE: MILLBANK ASSUMES WALL THICKNESS TO BE 89 MM.

CATEGORY: FOUNDATION INPUT NO: 520

COMPUTER PROMPT: AVERAGE HEIGHT ABOVE GRADE
OF THE FOUNDATION WALL.

DATA FORM FORMAT: HGT. ABOVE GRADE
509 ☐|☐

ADVISOR QUESTION:

RESPONSE RANGE:

0.0 - 9.9

DESCRIPTION:

THIS IS THE AVERAGE HEIGHT ABOVE GRADE OF THE FOUNDATION WALL (9) MEASURED BY THE ADVISOR DURING THE EXTERIOR INSPECTION.

PROGRAM USE: USED IN BASEMENT HEAT LOSS CALCULATIONS

MILLBANK REFERENCE: QUESTIONS 55 - 62 NO TABLE LOOK-UP REQUIRED IN ADS PROGRAM.

CATEGORY: FOUNDATION INPUT NO: 521

COMPUTER PROMPT: DEPTH OF INSULATION ON THE FOUNDATION WALL

DATA FORM FORMAT:

DEPTH OF INSUL.
521 ☐|☐

ADVISOR QUESTION:

RESPONSE RANGE:

0.0 - 9.9

DESCRIPTION:

THIS QUESTION IS TO DETERMINE IF FOUNDATION WALL IS PARTIALLY, A FEW FEET BELOW GRADE, OR FULLY INSULATED TO THE BOTTOM OF THE WALL.

PROGRAM USE: USED IN BASEMENT HEAT LOSS CALCULATIONS

MILLBANK REFERENCE: QUESTIONS 55 - 62 NO TABLE LOOK-UP REQUIRED IN ADS PROGRAM.

CATEGORY: FOUNDATION INPUT NO: 522

COMPUTER PROMPT: AVERAGE HEIGHT ABOVE GRADE OF
THE ADDED FOUNDATION WALL

DATA FORM FORMAT: 502 ☐.☐

ADVISOR QUESTION:

RESPONSE RANGE:

0.0 - 9.9

DESCRIPTION:

THE AVERAGE HEIGHT ABOVE GRADE OF THE ADDED FOUNDATION (10) MEASURED BY THE ADVISOR DURING THE EXTERIOR INSPECTION.

PROGRAM USE: USED IN BASEMENT HEAT LOSS CALCULATIONS

MILLBANK REFERENCE: QUESTIONS 55 - 62 NO TABLE LOOK-UP REQUIRED IN ADS PROGRAM.

CATEGORY: FOUNDATION INPUT NO:523

COMPUTER PROMPT: DEPTH OF INSULATION ON THE ADDED FOUNDATION WALL

DATA FORM FORMAT: 523 ☐.☐

ADVISOR QUESTION:

RESPONSE RANGE:

0.0 - 9.9

DESCRIPTION:

THIS QUESTION IS USED TO DETERMINE IF FOUNDATION WALL IS PARTIALLY INSULATED, A FEW FEET BELOW GRADE, OR FULLY INSULATED TO THE BOTTOM OF THE WALL.

PROGRAM USE: USED IN BASEMENT HEAT LOSS CALCULATIONS

MILLBANK REFERENCE: QUESTIONS 55 - 62 NO TABLE LOOK-UP REQUIRED IN ADS PROGRAM.

CATEGORY: EFFICIENCY TEST RESULTS INPUT NO: 045

COMPUTER PROMPT: DOMESTIC H.W. EFFICIENCY

DATA FORM FORMAT: ☐☐.☐
DOMESTIC HOT WATER HEATER EFFICIENCY

ADVISOR QUESTION:

RESPONSE RANGE:

44.0 - 99.9

DESCRIPTION:

STEADY STATE EFFICIENCY IS MEASURED AS A PERCENTAGE USING THE FURNACE EFFICIENCY TESTER. DECIMAL POINT IS NOT ENTERED ON COMPUTER.

IF TEST HOLE IS TOO CLOSE TO DAMPER, HOLD DAMPER CLOSED WHILE TESTING. IF ELECTRIC D.H. WATER HEATER INPUT 999

PROGRAM USE: CALCULATED HEATING COST, FURNACE RETROFIT RECOMMENDATIONS

MILLBANK REFERENCE: QUESTION 195 NO CHANGE

Appendix V-E

Program Listings

```
5 'AUDIT  --  AUDIT  --  AUDIT  --  AUDIT  --  AUDIT
10 OPTION BASE 1 : COMMON FILENAME$
20 DIM ANSWER$(800)
30 DIM QUE$(800),SECTION$(54)
31 PRINT CHR$(&H1A)
32 PRINT"YOUR DISK SET SHOULD BE FOR ST. JOHN'S.
    IF NOT YOU ARE USING THE WRONG DISK SET"
33 FOR J=1 TO 2000 : NEXT J
60 NUMADVISORS%=12 : DIM ADVINIT$(12) :
        FOR L%=1 TO NUMADVISORS% :
        READ ADVINIT$(L%) :
        NEXT L%
70 DATA BRY,TMC,DGW,DAS,GOB,RJM,FPG,FJD,MMO,DCS
80 DATA MJW,AAD," "
90 DIM NFLDEXCHANGE$(18) : NUMEXCHANGES%=18 :
        FOR L%=1 TO NUMEXCHANGES% :
        READ NFLDEXCHANGE$(L%) :
        NEXT L%
100 DATA 364,368,576,579,722,726,737,739,753,754
110 DATA 772,778,437,834,895.335,334
```

```
200 '*******************************************************
210 ' SECTION 1 -- CONTACT -- DATUM 1-5
220 SECTOR%=1 : FIRST.Q.IN.SECT%=1 : Q.IN.SECT%=5 :
      GOSUB 12000
230 DATA AUDIT DATE,ADVISOR'S INITIALS,INTERVIEWEE
240 DATA AREA CODE.TELEPHONE NUMBER
250 SECTION$(SECTOR%)="CONTACT"
260 GOSUB 11900 :'BUMP QUESTION%
270 IF QUESTION%=FIRST.Q.IN.SECT%+Q.IN.SECT%
      THEN 470
280 IF QUESTION%=4 THEN 330
      ELSE GOSUB 11400 :'GET DATUM$-SKIP AREA CODE
290 IF QUESTION%=1 THEN RIGHTLENGTH%=6
      ELSE IF QUESTION%=2 THEN RIGHTLENGTH%=3
      ELSE IF QUESTION%=3 THEN RIGHTLENGTH%=21
      ELSE RIGHTLENGTH%=7
300 IF QUESTION%=3 THEN LCODE%=
      ELSE IF QUESTION%=5 THEN LCODE%=4
      ELSE LCODE%=1
310 GOSUB 11200 : IF ERRFLAG%=0 THEN 330
320 GOSUB 11500 : GOTO 290 :'BAD DATUM$
330 Q%=QUESTION%-FIRST.Q.IN.SECT%+1 :
      ON Q% GOTO 340,370,360,400,420
340 'AUDIT DATE
350 GOSUB 10800 : IF ERRFLAG%>0 THEN 320
360 ANSWER$(QUESTION%)=DATUM$ :
      GOTO 260
370 'ADVISOR'S INITIALS
380 FOR L%=1 TO NUMADVISORS% :
      IF DATUM$=ADVINIT$(L%) THEN 360
      ELSE NEXT L%
390 GOTO 320
400 'AREA CODE -- ALWAYS 709
410 ANSWER$(QUESTION%)="709" :
      GOTO 260
420 'TELEPHONE NUMBER
430 IF LENGTHLINE%=0 THEN 360 :
      'NO PHONE
440 GOSUB 11300 : IF ERRFLAG%>0 THEN 320 :
      'EDIT PREFIX FOR NFLD EXCHANGES
450 TEMP$=LEFT$(DATUM$,3) :
      FOR L%=1 TO NUMEXCHANGES% :
      IF TEMP$=NFLDEXCHANGE$(L%) THEN 360
      ELSE NEXT L%
460 GOTO 320
470 'FINISHED SECTION 1 -- VERIFY
480 GOSUB 11600 :
      IF VERIFY$<>""THEN 280
```

```
500 '**********************************************************
510 ' SECTION 2 -- ADDRESS -- DATUM 6-14
520 SECTOR%=2 : FIRST.Q.IN.SECT%=6 : Q.IN.SECT%=9 :
      GOSUB 12000
530 DATA HOME OWNER
540 DATA MAILING ADDRESS,POST OFFICE/TOWN
550 DATA PROVINCE,POSTAL CODE
560 DATA HOME ADDRESS
570 DATA VILLAGE
580 DATA PROVINCE, METER NUMBER
590 SECTION$(SECTOR%)="ADDRESS"
600 GOSUB 11900 :'BUMP QUESTION%
610 IF QUESTION%=FIRST.Q.IN.SECT%+Q.IN.SECT%
      THEN 860
620 IF QUESTION%=9 OR QUESTION%=13
      THEN 670
      ELSE GOSUB 11400 :'GET DATUM$-SKIP PROVINCE
630 IF (QUESTION%=8 OR QUESTION%=12)THEN RIGHTLENGTH%=13
      ELSE IF QUESTION%=14 THEN RIGHTLENGTH%=10
      ELSE IF QUESTION%=10 THEN RIGHTLENGTH%=6
      ELSE RIGHTLENGTH%=21
640 IF (QUESTION%=6 OR QUESTION%=11 OR QUESTION%=12)
      THEN LCODE%=2
      ELSE IF (QUESTION%=7 OR QUESTION%=8)
      THEN LCODE%=3 ELSE LCODE%=1
650 GOSUB 11200 : IF ERRFLAG%=0 THEN 670
660 GOSUB 11500 : GOTO 630 :'BAD DATUM$
670 Q%=QUESTION%-FIRST.Q.IN.SECT%+1 :
      ON Q% GOTO 680,680,680,750,770,680,680,750,820
680 'HOMEOWNER-MAILING ADDRESS-HOME ADDRESS
      ALL 21 CHARACTER STRINGS-THE FIRST & THIRD
      MAY BE BLANK
690 ' POST OFFICE/TOWN - CITY/TOWN
      BOTH 13 CHAR. STRINGS-THE SECOND
      MAY BE BLANK.
700 ANSWER$(QUESTION%)=DATUM$
710 IF QUESTION%=6 AND LENGTHLINE%=0
      THEN ANSWER$(6)=ANSWER$(3)
720 IF QUESTION%=11 AND LENGTHLINE%=0
      THEN ANSWER$(11)=ANSWER$(7)
730 IF QUESTION%=12 AND LENGTHLINE%=0
      THEN ANSWER$(12)=ANSWER$(8)
740 GOTO 600
750 ' PROVINCE -- ALWAYS NFLD & LAB
760 ANSWER$(QUESTION%)="NFLD" :
      GOTO 600
```

```
770 ' POSTAL CODE
780 ' SPECIAL EDIT FOR POSTAL CODE
      BYTES ARE A1B2C3
790 FOR L%=1 TO 5 STEP 2 :
      TEMP$=MID$(DATUM$,L%,1) :
      IF TEMP$<"A" OR TEMP$>"Z" THEN 660
      ELSE NEXT L%
800 FOR L%=2 TO 6 STEP 2 :
      TEMP$=MID$(DATUM$,L%,1) :
      IF TEMP$<"0" OR TEMP$>"9" THEN 660
      ELSE NEXT L%
810 GOTO 700
820 'METER NUMBER NNNNNN NNN
830 DATUM$=LEFT$(DATUM$,6)+RIGHT$(DATUM$,3) :
      'GET RID OF THE EMBEDDED SPACE
840 LENGTHLINE%=LENGTHLINE%-1 : GOSUB 11300 :
      IF ERRFLAG%>0 THEN 660
850 ANSWER$(QUESTION%)=LEFT$(DATUM$,6)+" "+RIGHT$(DATUM$,3) :
      GOTO 600
860 'FINISHED SECTION 2 -- VERIFY
870 GOSUB 11600 :
      IF VERIFY$<>"" THEN 620
```

```
900 '************************************************************
910 ' SECTION 3 -- IDENTIFICATION -- DATUM 21-27
920 SECTOR%=3 : FIRST.Q.IN.SECT%=21 : Q.IN.SECT%=7 :
        GOSUB 12000
930 DATA TYPE OF HOME,AGE,NO. OF FLOORS
940 DATA TYPE OF STRUCTURE,SHAPE
950 DATA TYPE OF FOUNDATION,NO. OF OCCUPANTS
960 SECTION$(SECTOR%)="IDENTIFICATION"
970 GOSUB 11900
980 IF QUESTION%=FIRST.Q.IN.SECT%+Q.IN.SECT%
        THEN 1170
990 GOSUB 11400 :'GET DATUM$
1000 LCODE%=1 : IF QUESTION%=22 THEN RIGHTLENGTH%=3
        ELSE IF (QUESTION%=23 OR QUESTION%=27)
        THEN RIGHTLENGTH%=2
        ELSE RIGHTLENGTH%=1
1010 GOSUB 11200 : IF ERRFLAG%=0 THEN 1030
1020 GOSUB 11500 : GOTO 1000 :'BAD DATUM$
1030 Q%=QUESTION%-FIRST.Q.IN.SECT%+1 :
        ON Q% GOTO 1040,1080,1110,1040,1040,1040,1140
1040 'FOUNDATION AND STRUCTURE (1-5)
                        TYPE  (1-6)
                        SHAPE (1-2)
1050 IF QUESTION%=25 THEN MAX$="2" ELSE
    IF QUESTION%=21 THEN MAX$="6" ELSE
    IF QUESTION%=26 THEN MAX$="5"
    ELSE MAX$="4"
1060 IF DATUM$<"1" OR DATUM$>MAX$ THEN 1020
1070 ANSWER$(QUESTION%)=DATUM$ :
        GOTO 970
1080 ' AGE OF HOME (1-200 YEARS)
1090 GOSUB 11300 :
        IF ERRFLAG%>0 THEN 1020
1100 IF VAL(DATUM$)<1 OR VAL(DATUM$)>200
        THEN 1020
        ELSE 1070 :'GOOD DATUM$
1110 'NUMBER OF FLOORS
1120 IF DATUM$<>"05" AND DATUM$<>"10"
        AND DATUM$<>"15" AND DATUM$<>"20"
        AND DATUM$<>"25" AND DATUM$<>"30"
        THEN 1020
1130 GOTO 1070 :'GOOD DATUM$
1140 'NUMBER OF OCCUPANTS (1 TO 30)
1150 GOSUB 11300 :
        IF ERRFLAG%>0 THEN 1020
1160 IF VAL(DATUM$)<1 OR VAL(DATUM$)>30
        THEN 1020
        ELSE 1070 :'GOOD DATUM$
1170 'FINISHED SECTION 3 -- VERIFY
1180 GOSUB 11600 :
        IF VERIFY$<>"" THEN 990
```

```
1200 '******************************************************
1210 'SECTION 4 -- TEMPERATURE -- DATUM 31-38
1220 SECTOR%=4 : FIRST.Q.IN.SECT%=31 : Q.IN.SECT%=8 :
     GOSUB 12000
1230 DATA DAY,EVENING,NIGHT
1235 DATA TEMPERATURE DIFFERENCE,% AREA
1240 DATA BASEMENT,WIND EXPOSURE
1250 DATA SOLAR EXPOSURE
1260 SECTION$(SECTOR%)="TEMPERATURE"
1270 GOSUB 11900
1280 IF QUESTION%=FIRST.Q.IN.SECT%+Q.IN.SECT%
     THEN 1420
1290 GOSUB 11400 : 'GET DATUM$
1300 LCODE%=1 : IF QUESTION%>36
     THEN RIGHTLENGTH%=1
     ELSE RIGHTLENGTH%=2
1310 GOSUB 11200 : IF ERRFLAG%=0 THEN 1330
1320 GOSUB 11500 : GOTO 1300 :'BAD DATUM$
1330 Q%=QUESTION%-FIRST.Q.IN.SECT%+1 :
     ON Q% GOTO 1340,1340,1340,1340,1340,1340,1390,1400
1340 'TEMPERATURES
1350 R2%=30 : IF Q%>3 THEN R1%=0
     ELSE R1%=5 :'MIN. BSMNT =0 - LVNG SPC =05
                 MAX ANYWHERE =30 DEGREES CEL.
1355 IF Q%=4 THEN R2%=20:'MAX ZONE 2 TEMP DIFF = 20
1360 GOSUB 11300 : IF ERRFLAG%>0 THEN 1320
1365 IF QUESTION%=35 THEN 1410
1370 T%=VAL(DATUM$) : GOSUB 10200 :
     IF ERRFLAG%>0 THEN 1320
1380 ANSWER$(QUESTION%)=RIGHT$(STR$(T%),2) :
     GOTO 1270
1390 'WIND AND SOLAR EXPOSURE -- 0,1 OR 0,1,2
1392 IF DATUM$<"0" OR DATUM$>"1" THEN 1320 ELSE 1410
1400 IF DATUM$<"0" OR DATUM$>"2" THEN 1320
1410 ANSWER$(QUESTION%)=DATUM$ : GOTO 1270
1420 'DONE SECTION 4 -- VERIFY
1430 GOSUB 11600 :
     IF VERIFY$<>"" THEN 1290
```

```
1500 '*********************************************
1510 'SECTION 5 -- WATER CONSUMPTION -- DATUM 41-44
1520 SECTOR%=5 : FIRST.Q.IN.SECT%=41 : Q.IN.SECT%=4 :
       GOSUB 12000
1530 DATA CLOTHES WASHER,DISH WASHER
1540 DATA BATHES/WEEK,SHOWERS/WEEK
1550 SECTION$(SECTOR%)="HOT WATER CONSUMPTION"
1560 GOSUB 11900 :'BUMP QUESTION%
1570 IF QUESTION%=FIRST.Q.IN.SECT%+Q.IN.SECT%
       THEN 1700
1580 GOSUB 11400 :'GET DATUM$
1590 LCODE%=1 : IF QUESTION%>42
       THEN RIGHTLENGTH%=2
       ELSE RIGHTLENGTH%=1
1600 GOSUB 11200 : IF ERRFLAG%=0 THEN 1620
1610 GOSUB 11500 : GOTO 1590 :'BAD DATUM$
1620 Q%=QUESTION%-FIRST.Q.IN.SECT%+1 :
       ON Q% GOTO 1630,1630,1660,1660
1630 'CLOTHES AND DISH WASHER
1640 IF DATUM$<"0" OR DATUM$>"1" THEN 1610
1650 ANSWER$(QUESTION%)=DATUM$ :
       GOTO 1560
1660 'BATHES & SHOWERS/WEEK RANGE 00-50
1670 GOSUB 11300 : IF ERRFLAG%>0 THEN 1610
1680 IF VAL(DATUM$)>50 THEN 1610 ELSE 1650
1690 ANSWER$(QUESTION%)=DATUM$ : GOTO 1560
1700 GOSUB 11600 :
       IF VERIFY$<>""THEN 1580
1800 '*********************************************
1810 'SECTION 6 -- HUMIDITY -- DATUM 51-54
1820 SECTOR%=6 : FIRST.Q.IN.SECT%=51 : Q.IN.SECT%=4 :
       GOSUB 12000
1830 DATA BASEMENT DAMP,CLOTHES DRYING
1840 DATA HUMIDIFIER USE,MOISTURE ASSESSMENT
1850 SECTION$(SECTOR%)="HUMIDITY"
1860 GOSUB 11900 :'BUMP QUESTION%
1870 IF QUESTION%=FIRST.Q.IN.SECT%+Q.IN.SECT%
       THEN 1950 :'VERIFY
1880 GOSUB 11400 :'GET DATUM$
1890 LCODE%=1 : RIGHTLENGTH%=1 :
       GOSUB 11200 :
       IF ERRFLAG%=0 THEN 1910
1900 GOSUB 11500 : GOTO 1890 :'BAD DATUM$
1910 'QUESTION    51  RANGE=0 - 1
               52-54  RANGE=0 - 2
1920 IF QUESTION%=51 THEN MAX$="1"
       ELSE MAX$="2"
1930 IF DATUM$<"0" OR DATUM$>MAX$ THEN 1900
1940 ANSWER$(QUESTION%)=DATUM$ : GOTO 1860
1950 GOSUB 11600 :
       IF VERIFY$<>"" THEN 1880
```

```
2000 '****************************************************
2010 'SECTION 7 -- HISTORY -- DATUM 61-65
2020 SECTOR%=7 : FIRST.Q.IN.SECT%=61 : Q.IN.SECT%=5 :
     GOSUB 12000
2030 DATA REINSULATION HISTORY,SEALING
2040 DATA PROBLEMS WITH HOME
2050 DATA RECEIVED CHIP,RECEIVED COSP
2060 SECTION$(SECTOR%)="HISTORY"
2070 GOSUB 11900 :'BUMP QUESTION%
2080 IF QUESTION%=FIRST.Q.IN.SECT%+Q.IN.SECT%
     THEN 2250 :'VERIFY
2090 GOSUB 11400 :'GET DATUM$
2100 IF QUESTION%=63 THEN LCODE%=3
     ELSE LCODE%=1
2110 IF QUESTION%=63
     THEN RIGHTLENGTH%=4
     ELSE RIGHTLENGTH%=1
2120 GOSUB 11200 :
     IF ERRFLAG%=0 THEN 2140
2130 GOSUB 11500 : GOTO 2100 :'BAD DATUM$
2140 Q%=QUESTION%-FIRST.Q.IN.SECT%+1 :
     ON Q% GOTO 2150,2150,2190,2150,2150
2150 'QUESTIONS 61&62  RANGE 0 - 2
                64&65  RANGE 0 - 1
2160 IF QUESTION%<63 THEN MAX$="2"
     ELSE MAX$="1"
2170 IF DATUM$<"0" OR DATUM$>MAX$ THEN 2130
2180 ANSWER$(QUESTION%)=DATUM$
     +SPACE$(RIGHTLENGTH%-LENGTHLINE%) :
     GOTO 2070
2190 'PROBLEMS WITH HOME -- ALL NUMERIC STRING
2200 GOSUB 11300 :
     IF ERRFLAG%>0 THEN 2130
2210 'LOOP TO EDIT STRING - TRIP OUT ON 0 IF FIRST AND ONLY
     VALID ENTRIES 1-4
2220 FOR L%=1 TO LENGTHLINE% :
     C$=MID$(DATUM$,L%,1) :
     IF C$="0" AND L%=1 AND LENGTHLINE%=1 THEN 2180
2230 IF C$<"1" OR C$>"4" THEN 2130
     ELSE NEXT L%
2240 GOTO 2180
2250 'ALL DONE -- VERIFY
2260 GOSUB 11600 :
     IF VERIFY$<>"" THEN 2090
```

```
2300 '*************************************************
2310 'SECTION 8 -- PRIMARY HEATING --
        PART 1 -- DATUM 70 - 72
        PART 2 -- FUEL RECORDS (SELECTIVELY SKIPPED)
2320 SECTOR%=8 : FIRST.Q.IN.SECT%=70 : Q.IN.SECT%=3 :
        GOSUB 12000
2330 DATA FUEL TYPE,METHOD TO COMPUTE CONSUMPTION
2335 DATA UNIT SERVICED REGULARLY
2340 SECTION$(SECTOR%)="PRIMARY HEATING"
2350 GOSUB 11900 :'BUMP QUESTION
2360 IF QUESTION%=FIRST.Q.IN.SECT%+Q.IN.SECT%
        THEN 2440 :'VERIFY
2370 GOSUB 11400 :'GET DATUM$
2380 IF LEN(DATUM$)=1 THEN 2400
2390 GOSUB 11500 : GOTO 2380 :'BAD DATUM$
2400 IF QUESTION%=70 THEN MAX$="6"
        ELSE IF QUESTION%=71 THEN MAX$="3"
        ELSE MAX$="1"
2410 IF QUESTION%=70 THEN MIN$="1"
        ELSE MIN$="0"
2420 IF DATUM$<MIN$ OR DATUM$>MAX$ THEN 2390
2430 ANSWER$(QUESTION%)=DATUM$ :
        GOTO 2350
2440 GOSUB 11600 :
        IF VERIFY$<>"" THEN 2370
```

```
2450 'SECTION 8 -- PART 2 -- FUEL BILLS
2460 IF ANSWER$(71)="0" THEN 2750 :
      'THERE IS FUEL DATA
2470 DATA DELIVERY DATE ( <RETURN> IF NO MORE )
2480 DATA UNITS,DOLLARS
2490 FOR EL%=73 TO 94 STEP 3 :
      FIRST.Q.IN.SECT%=EL% : Q.IN.SECT%=3 :
      GOSUB 12000
2500 IF EL%>73 THEN 2530
2510 FOR M%=76 TO 94 STEP 3 :
      QUE$(M%)=QUE$(73) : QUE$(M%+1)=QUE$(74) :
      QUE$(M%+2)=QUE$(75)
2520 NEXT M%
2530 GOSUB 11900 :'BUMP QUESTION
2535 IF ANSWER$(71)<>"1" THEN 2555
2540 IF ANSWER$(70)<>"4" THEN
      QUESTION%=QUESTION%+2
2545 IF ANSWER$(70)="4" AND QUESTION%=73 THEN
      QUESTION%=QUESTION%+1
2550 IF QUESTION%>75 THEN 2710
      ELSE 2560
2555 IF QUESTION%=74 THEN QUESTION%=76
2560 IF QUESTION%=FIRST.Q.IN.SECT%+Q.IN.SECT%
      THEN 2710 :'VERIFY
2570 GOSUB 11400 :'GET DATUM$
2580 IF QUESTION%=EL% AND DATUM$=""
      THEN 2810 :'ALL DONE
2590 LCODE%=1 : IF QUESTION%=EL% THEN RIGHTLENGTH%=6
      ELSE RIGHTLENGTH%=4
2595 IF QUESTION%=74 AND ANSWER$(70)="4"
      THEN LCODE%=4
2600 GOSUB 11200 :
      IF ERRFLAG%=0 THEN 2620
2610 GOSUB 11500 : GOTO 2590 :'BAD DATUM$
2620 Q%=QUESTION%-FIRST.Q.IN.SECT%+1 :
      ON Q% GOTO 2630,2660,2660
2630 'DELIVERY DATE
2640 GOSUB 10800 : IF ERRFLAG%>0 THEN 2610
2650 ANSWER$(QUESTION%)=DATUM$ :
      GOTO 2530
2660 'UNITS DELIVERED AND COST
2670 GOSUB 11300 :
      IF ERRFLAG%>0 THEN 2610
2680 GOTO 2650
2710 GOSUB 11600 :
      IF VERIFY$<>"" THEN 2570
2720 IF ANSWER$(71)="1"
      AND QUESTION%>75
      THEN 2810
2730 NEXT EL%
2740 GOTO 2810
2750 FOR EL%=1 TO 3 :
      READ DATUM$ :
      NEXT EL% :'DUMMY READ LOOP TO
                SPACE OVER DATA QUES
```

```
2800 '*******************************************************
2810 'SECTION 9 -- SECONDARY HEAT -- DATUM 101-107
2820 SECTOR%=9 : FIRST.Q.IN.SECT%=101 :
       Q.IN.SECT%=7 : GOSUB 12000
2830 DATA FUEL,TYPE,QUANTITY,DOLLARS
2835 DATA WOOD POTENTIAL,$/CORD,CHIMNEY
2840 SECTION$(SECTOR%)="SECONDARY HEATING AND WOOD POTENTIAL"
2850 GOSUB 11900 :'BUMP QUESTION
2860 IF QUESTION%=FIRST.Q.IN.SECT%+Q.IN.SECT%
       THEN 3070 :'VERIFY
2865 IF ANSWER$(101)="0"
     AND QUESTION%<105
     THEN QUESTION%=105
2867 IF QUESTION%=106 AND ANSWER$(105)="0"
       THEN 3070
2870 GOSUB 11400 :'GET DATUM$
2880 LCODE%=1 : IF QUESTION%=106 THEN RIGHTLENGTH%=3
       ELSE IF (QUESTION%=103 OR QUESTION%=104) THEN
       RIGHTLENGTH%=4 ELSE RIGHTLENGTH%=1
2890 GOSUB 11200 :
       IF ERRFLAG%=0 THEN 2920
2900 GOSUB 11500 : GOTO 2880 :'BAD DATUM$
2920 Q%=QUESTION%-FIRST.Q.IN.SECT%+1 :
       ON Q% GOTO 2930,2955,2960,2960,2990,3000,3010
2930 'FUEL TYPE
2940 IF DATUM$<"0" OR DATUM$>"6" THEN 2900
2950 ANSWER$(QUESTION%)=DATUM$ : GOTO 2850
2955 IF DATUM$<"1" OR DATUM$>"4" THEN 2900 ELSE 2950
2960 'QUANTITY AND DOLLARS
2970 GOSUB 11300 :
       IF ERRFLAG%>0 THEN 2900
2980 IF VAL(DATUM$)=0 THEN 2900
       ELSE 2950
2990 IF DATUM$<"0" OR DATUM$>"3" THEN 2900 ELSE 2950
3000 IF VAL(DATUM$)<40 OR VAL(DATUM$)>150
       THEN 2900 ELSE 2950
3010 IF DATUM$<"0" OR DATUM$>"1" THEN 2900 ELSE 2950
3070 GOSUB 11600 :
       IF VERIFY$<>""THEN 2870
```

```
3100 '**************************************************
3110 'SECTION 10 -- ELECTRICITY -- DATUM 108-157
        PART 1 -- DATUM 108
        PART 2 -- ELECTRIC BILLS (SELECTIVELY SKIPPED)
3120 SECTOR%=10 : FIRST.Q.IN.SECT%=108 : Q.IN.SECT%=1 :
        GOSUB 12000
3130 DATA METER FOR HOME ONLY
3140 SECTION$(SECTOR%)="ELECTRICITY"
3150 GOSUB 11900 :'BUMP QUESTION
3160 IF QUESTION%=FIRST.Q.IN.SECT%+Q.IN.SECT%
        THEN 3220 :'VERIFY
3170 GOSUB 11400 :'GET DATUM$
3180 IF LEN(DATUM$)=1 THEN 3200
3190 GOSUB 11500 : GOTO 3180 :'BAD DATUM$
3200 IF DATUM$<>"0" AND DATUM$<>"1" THEN 3190
3210 ANSWER$(QUESTION%)=DATUM$ : GOTO 3150
3220 GOSUB 11600 : IF VERIFY$<>"" THEN 3170
```

```
3230 'SECTION 10 -- PART 2 -- ELECTRIC BILLS
3240 IF ANSWER$(108)="0" THEN 3500 :
        'THE METER IS FOR HOME ONLY
3250 DATA DAYS ( <RETURN> IF NO MORE )
3260 DATA DATE,KWH,ESTIMATE
3270 FOR EL%=110 TO 154 STEP 4 :
       FIRST.Q.IN.SECT%=EL% : Q.IN.SECT%=4 :
       GOSUB 12000
3280 IF EL%>110 THEN 3310
3290 FOR M%=114 TO 154 STEP 4 :
       QUE$(M%)=QUE$(110) : QUE$(M%+1)=QUE$(111) :
       QUE$(M%+2)=QUE$(112) : QUE$(M%+3)=QUE$(113)
3300 NEXT M%
3310 GOSUB 11900 :'BUMP QUESTION
3320 IF QUESTION%=FIRST.Q.IN.SECT%+Q.IN.SECT%
       THEN 3470 :'VERIFY
3330 GOSUB 11400 :'GET DATUM$
3340 IF QUESTION%=EL% AND DATUM$=""
       THEN 3610 :'ALL DONE
3350 LCODE%=1 : IF QUESTION%=EL% THEN RIGHTLENGTH%=2
       ELSE IF QUESTION%=EL%+1 THEN RIGHTLENGTH%=6
       ELSE IF QUESTION%=EL%+2 THEN RIGHTLENGTH%=4
       ELSE RIGHTLENGTH%=1
3360 GOSUB 11200 : IF ERRFLAG%=0 THEN 3380
3370 GOSUB 11500 : GOTO 3350 :'BAD DATUM$
3380 Q%=QUESTION%-FIRST.Q.IN.SECT%+1 :
       ON Q% GOTO 3390,3450,3390,3390
3390 'DAYS, KWH, AND ESTIMATE
3400 GOSUB 11300 : IF ERRFLAG%>0 THEN 3370
3410 IF QUESTION%=EL% THEN MAX%=40
       ELSE IF QUESTION%=EL%+2 THEN MAX%=9000
       ELSE MAX%=1
3420 IF QUESTION%=EL% THEN MIN%=20
       ELSE IF QUESTION%=EL%+2 THEN MIN%=50
       ELSE MIN%=0
3430 IF VAL(DATUM$)<MIN% OR VAL(DATUM$)>MAX%
       THEN 3370
3440 ANSWER$(QUESTION%)=DATUM$ : GOTO 3310
3450 'DATE
3460 GOSUB 10800 : IF ERRFLAG%>0 THEN 3370
       ELSE 3440
3470 GOSUB 11600 : IF VERIFY$<>"" THEN 3330
3480 NEXT EL%
3490 GOTO 3610
3500 FOR EL%=1 TO 4 :
       READ DATUM$ :
       NEXT EL% :'DUMMY READ LOOP TO
                  SPACE OVER DATA QUES
```

```
3600 '**************************************************
3610 'END OF PAGE 1 -- DUMP DATA TO DISC B
        MAKE ROOM FOR PAGE 2
3620 GOSUB 12100
3630 FILENAME$="B:X"+LEFT$(ANSWER$(14),6)+"."
        +RIGHT$(ANSWER$(14),3)
3640 OPEN "O",#1,FILENAME$
3650 FOR QUESTION%=1 TO 200 :
        PRINT#1,ANSWER$(QUESTION%) :
        NEXT QUESTION%
3660 CHAIN MERGE "AUDIT2.SJ4",,ALL,DELETE 10-3660
```

```
10199 STOP
10200 ' ******************************
        *******  TEMPEDIT.SUB  *******
        ******************************
10210 ' SUBROUTINE TO EDIT TEMPERATURE DATA.
        T% = TEMP. TO EDIT
        R1% - R2% (SET IN MAINLINE) = RANGE
        CONVERTS FAR. TO CEL. AUTOMATICALLY
10220 ERRFLAG%=0 :
        IF T%>30 THEN T%=(T%-32)/1.8
10230 IF T%<R1% OR T%>R2% THEN ERRFLAG%=1
10240 RETURN
10799 STOP
10800 ' ******************************
        *******  EDITDATE.SUB  *******
        ******************************
10810 ' SUB TO EDIT DATE STRING
        FORMAT YYMMDD
        ERROR RETURNS ERRFLAG%>0
10820 ' ERRFLAG% ERROR PATTERN
        0001=STRING LENGTH TOO LONG
        0010=MONTH NOT 1-12
10830 ' 0100=YEAR NOT 81 OR 82
        1000=TOO MANY [OR <0] DAYS IN MONTH
        1111=ADDITIVE WORST CASE EXAMPLE
10840 ERRFLAG%=0:
        IF LEN(DATUM$)<>6 THEN ERRFLAG%=1
10850 L%=VAL(MID$(DATUM$,3,2)) :
        IF L%>=1 AND L%<=12 THEN 10880
10870 ERRFLAG%=ERRFLAG%+10
10880 ' EDIT YEAR -- 81 AND 82 ACCEPTED
10890 A$=LEFT$(DATUM$,2):
        IF A$<>"81" AND A$<>"82"
        THEN ERRFLAG%=ERRFLAG%+100
10900 ' DAY OF MONTH EDIT -- CONSIDERS LEAP YEAR
10910 M%=VAL(MID$(DATUM$,5,2)):
        LL%=VAL(A$) : N%=28 :
        IF LL% MOD 4 =0 THEN N%=29
10920 IF L%=2 AND M%>N% THEN ERRFLAG%=ERRFLAG%+1000
10930 IF (L%=4 OR L%=6 OR L%=9 OR L%=11) AND
        M%>30 THEN ERRFLAG%=ERRFLAG%+1000
10940 IF M%>31 OR M%<1 THEN ERRFLAG%=ERRFLAG%+1000
10950 RETURN
```

```
11199 STOP
11200 ' *****************************
      *******  LONGLINE.SUB  *******
      *****************************
11210 ' SUB TO EDIT CHARACTER STRING LENGTH
      LCODE%=1=LINE MUST BE = TO RIGHTLENGTH%
             2=     MUST BE<=
             3=     MUST BE<= AND >0
11211 '      4=     MUST BE = OR 0 [NULL LINE]
11220 ERRFLAG%=0 : LENGTHLINE%=LEN(DATUM$):
      ON LCODE% GOTO 11240,11250,11260,11265
11240 IF LENGTHLINE%=RIGHTLENGTH% THEN 11290
      ELSE 11270
11250 IF LENGTHLINE%<=RIGHTLENGTH% THEN 11290
      ELSE 11270
11260 IF LENGTHLINE%<=RIGHTLENGTH%
      AND LENGTHLINE%>0 THEN 11290
      ELSE 11270
11265 IF LENGTHLINE%=RIGHTLENGTH% OR
      LENGTHLINE%=0
      THEN 11290
11270 ERRFLAG%=1
11290 RETURN
11299 STOP
11300 ' *****************************
      *******  ALLNUMBR.SUB  *******
      *****************************
11310 ' SUB TO EDIT STRING FOR NON-NUMERICS
      RETURNS ERRFLAG>0 IF NON-NUMERIC FOUND
                VALUE=POS OF 1ST NON-NUMERIC
11320 ERRFLAG%=0 : FOR L%=1 TO LENGTHLINE% :
      TEMP$=MID$(DATUM$,L%,1) :
      IF TEMP$<"0" OR TEMP$>"9" THEN 11350
11330 NEXT L%
11340 RETURN :
      'ERROR TRAP
11350 ERRFLAG%=L% :
      RETURN
```

```
11399 STOP
11400 ' ******************************
      ********  PROMPT.SUB  ********
      ******************************
11410 ' QUE UP AND ACCEPT DATA INPUT
11420 LYNE%=LYNE%+2 :
      IF LYNE%<20 THEN 11440
      ELSE PRINT CHR$(&H1A)
11430 LYNE%=0 : PRINT CHR$(&H1B);CHR$(&H6C);
      CHR$(&H1B);CHR$(&H29);SECTION$(SECTOR%);
      " SECTION";CHR$(&H1B);CHR$(&H28);
      CHR$(&H1B);CHR$(&H6D)
11440 PRINT CHR$(&H1B);CHR$(&H6C);"(";QUESTION%;")  ";
      QUE$(QUESTION%);CHR$(&H1B);CHR$(&H6D);":"
11450 LINE INPUT DATUM$ :
      RETURN
11499 STOP
11500 ' ******************************
      *******  ERRHNDLR.SUB  *******
      ******************************
11510 ' ERROR HANDLING ROUTINE -- ALERTS
      PROMPTS AND REPOSITIONS CURSER
      AND ACCEPTS NEW DATUM$.
11520 FOR L%=1 TO  15 :
      PRINT CHR$(&H7); : NEXT L%
11530 PRINT "INVALID DATA -- TRY AGAIN PLEASE.";
11540 PRINT CHR$(&HB);CHR$(&HD);CHR$(&H1B);CHR$(&H29);
      DATUM$;CHR$(&H1B);CHR$(&H28);CHR$(&HD);
11550 GOSUB 11450
11560 PRINT CHR$(&H1B);CHR$(&H54);CHR$(&HB):
      RETURN
```

```
11599 STOP
11600 ' ******************************
         ********  VERIFY.SUB  ********
         ******************************
11610 ' VERIFY A SCREEN OF DATA
11615 VERIFY%=1
11620 PRINT CHR$(&H1A);CHR$(&H1B);CHR$(&H29);
         SECTION$(SECTOR%);" SECTION";
         CHR$(&H1B);CHR$(&H28)
11630 FOR L%=FIRST.Q.IN.SECT% TO
              FIRST.Q.IN.SECT%+Q.IN.SECT%-1
11640 PRINT CHR$(&H1B);CHR$(&H29);CHR$(&H1B);CHR$(&H6C);
         "(";L%;")";QUE$(L%);
         CHR$(&H1B);CHR$(&H28);CHR$(&H1B);CHR$(&H6D)
11650 PRINT ANSWER$(L%) :
         NEXT L%
11655 PRINT
11660 PRINT CHR$(&H1B);CHR$(&H6C);
         "VERIFY (TYPE NUMBER TO CHANGE/RETURN TO PROCEED)";
         CHR$(&H1B);CHR$(&H6D); :
         LINE INPUT VERIFY$
11670 IF VERIFY$="" THEN RETURN
11675 LENGTHLINE%=LEN(VERIFY$) : DATUM$=VERIFY$ : GOSUB 11300 :
         IF ERRFLAG%>0 THEN 11690
11677 IF LENGTHLINE%>3 THEN 11690
11680 QUESTION%=VAL(VERIFY$) :
         IF QUESTION%>=FIRST.Q.IN.SECT%
         AND QUESTION%<FIRST.Q.IN.SECT%+Q.IN.SECT%
         THEN 11700
11690 PRINT CHR$(&HB);CHR$(&H1B);CHR$(&H54); :
         GOTO 11660
11700 LYNE%=20 :
         RETURN
11800 ' ******************************
         *******  FILLQUE.SUB  ********
         ******************************
11810 ' LOOP TO FILL QUE$(N) AT BEGINNING
                OF A SECTION.
11815 IF SECTOR%=8 AND QUESTION%>73 THEN RETURN
11816 IF SECTOR%=10 AND QUESTION%>110 THEN RETURN
11817 IF SECTOR%=12 AND QUESTION%>280 THEN RETURN
11820 FOR L%=FIRST.Q.IN.SECT% TO
         QUESTION%+Q.IN.SECT% :
         READ QUE$(L%) :
         NEXT L%
11830 RETURN
```

```
11900 ' ******************************
        *********  BUMP.SUB  *********
        ******************************
11910 ' INCREMENT QUESTION NUMBER
11920 QUESTION%=QUESTION%+1 :
        IF VERIFY%=1 THEN QUESTION%=
        FIRST.Q.IN.SECT%+Q.IN.SECT%
11930 RETURN
11999 STOP
12000 ' ******************************
        *******  SECTINIT.SUB  *******
        ******************************
12010 ' INITIALIZE THE VARIABLES AT START
        OF EACH SECTION.
12020 VERIFY%=0 : LYNE%=20 :
        QUESTION%=FIRST.Q.IN.SECT%-1 :
        GOSUB 11800 :
        RETURN
12099 STOP
12100 ' *****************************
        ********  ENDPAGE.SUB  ******
        *****************************
12105 ' SELF DOCUMENTING
12120 PAGE%=PAGE%+1 : PRINT CHR$(&H1A) :
        FOR L%=1 TO 4 : PRINT "CONGRATULATIONS  "; :
        NEXT L%
12125 PRINT : FOR L%=1 TO 5 : PRINT "GOOD WORK  ";:
        NEXT L%
12130 PRINT : FOR L%=1 TO 3 : PRINT "PAGE";PAGE%;
        " IS FINISHED  "; : NEXT L%
12135 PRINT:PRINT:PRINT "     BEFORE I FORGET EVERYTHING, I WILL STORE THE"
12140 PRINT "INFORMATION YOU HAVE TYPED ON MY DATA STORAGE"
12145 PRINT "DISC.  YOU HAVE DONE SO WELL TO THIS POINT THAT"
12150 PRINT "MY BRAIN IS GETTING FULL.  AFTER I PUT AWAY THE"
12155 PRINT "DATA I WILL HAVE TO SWEEP OUT A FEW COBWEBS FROM"
12160 PRINT "MY MEMORY."
12170 IF PAGE%>1 THEN 12215
12175 PRINT : PRINT STRING$(52,"*") : PRINT STRING$(52,"*")
12180 PRINT : PRINT "IMPORTANT!  THE PROPER DATA STORAGE DISC MUST"
12185 PRINT SPC(12);"BE IN DRIVE B.  CONFIRM FOR ME THAT"
12190 PRINT SPC(12);"IT IS BY PRESSING THE <RETURN> KEY."
12200 PRINT : PRINT STRING$(52,"*") : PRINT STRING$(52,"*")
12210 LINE INPUT DATUM$ : PRINT CHR$(&H1A)
12215 PRINT : PRINT "     THIS IS A GOOD TIME TO LOOK AWAY, REST"
12220 PRINT "YOUR EYES, AND TURN THE PAGE.  PLEASE DON'T"
12225 PRINT "SMOKE NEAR ME.  SMOKE IS HAZARDOUS TO MY HEALTH."
12230 PRINT : PRINT "     I'LL WHISTLE WHEN IT IS TIME TO GO ON."
12299 RETURN
```

```
5 COMMON FILENAME$
10 FOR L%=1 TO 250 : PRINT CHR$(&H7); : NEXT L%
20 'AUDIT2 -- AUDIT2 -- AUDIT2 -- AUDIT2
30 'SECTION 11 -- INFILTRTION -- DATUM 201-273
40 SECTOR%=11 : SECTION$(SECTOR%)="INFILTRATION"
50 VERIFY$=""
60 FOR L%=1 TO 7 : READ KON%(L%) : NEXT L%
70 DATA 201,209,221,229,241,249,261
80 LCODE%=1 : Q.IN.SECT%=8
90 FOR M%=1 TO 7 : LYNE%=20 : IF M%=7
        THEN RIGHTLENGTH%=3
        ELSE RIGHTLENGTH%=4
100 FIRST.Q.IN.SECT%=KON%(M%)
110 FOR QUESTION%=KON%(M%) TO KON%(M%)+7
120 ON M% GOTO 130,130,140,140,150,150,170
130 QUE$(QUESTION%)="SMALL" : GOTO 160
140 QUE$(QUESTION%)="MEDIUM" : GOTO 160
150 QUE$(QUESTION%)="LARGE"
160 QUE$(QUESTION%)=QUE$(QUESTION%)+" WINDOW" :
        GOTO 180
170 QUE$(QUESTION%)="DOOR"
180 QUE$(QUESTION%)=QUE$(QUESTION%) +
        " ( <RETURN> IF NO MORE )"
190 GOSUB 11400 :'GET DATUM$
200 IF DATUM$="" THEN 330 :'DONE
210 GOSUB 11200 : IF ERRFLAG%=0 THEN 230
220 GOSUB 11500 : GOTO 210 :'BAD DATUM$
230 IF M%=7 THEN MAX%=3 ELSE MAX%=4
240 FOR EL%=1 TO MAX% : C$=MID$(DATUM$,EL%,1) :
        ON EL% GOTO 250,260,270,280
250 IF C$<"1" OR C$>"9" OR C$="4"THEN 220
        ELSE 290
260 IF C$<"1" OR C$>"3" THEN 220
        ELSE 290
270 IF C$<"0" OR C$>"1" THEN 220
        ELSE 290
280 IF C$<"1" OR C$>"4" THEN 220
290 NEXT EL%
300 ANSWER$(QUESTION%)=DATUM$
310 IF VERIFY$<>"" THEN 330
320 NEXT QUESTION%
330 GOSUB 11600 : IF VERIFY$<>"" THEN 190
340 IF DATUM$<>"" THEN 360
350 IF M%=1 OR M%=3 OR M%=5 THEN M%=M%+1
360 NEXT M%
```

```
400 '***************************************************
410 'SECTION 11 -- PART2 -- BUILDING SEAL
420 FIRST.Q.IN.SECT%=271 : Q.IN.SECT%=3 :
      GOSUB 12000
430 DATA BASEMENT SEAL,TRIM SEAL,ATTIC SEAL
440 GOSUB 11900 :'BUMP QUESTION%
450 IF QUESTION%=FIRST.Q.IN.SECT%+Q.IN.SECT%
      THEN 510 :'VERIFY
460 GOSUB 11400 :'GET DATUM$
470 IF LEN(DATUM$)=1 THEN 490
480 GOSUB 11500 : GOTO 470 :'BAD DATUM$
490 IF DATUM$<"0" OR DATUM$>"2" THEN 480
500 ANSWER$(QUESTION%)=DATUM$ : GOTO 440
510 GOSUB 11600 : IF VERIFY$<>"" THEN 460
600 '*************************************************
610 'SECTION 12 -- THERMOSTAT -- DATUM 280-282
620 SECTOR%=12 : SECTION$(SECTOR%)="THERMOSTAT"
630 DATA INDOOR TEMPERATURE
640 DATA CUT-IN TEMPERATURE
650 DATA AUTOMATIC SET-BACK DEVICE
660 FIRST.Q.IN.SECT%=280 : Q.IN.SECT%=3 :
      GOSUB 12000
690 GOSUB 11900 :'BUMP QUESTION%
700 IF QUESTION%=FIRST.Q.IN.SECT%+Q.IN.SECT%
      THEN 830 :'VERIFY
710 GOSUB 11400 :'GET DATUM$
730 LCODE%=1 : IF QUESTION%=FIRST.Q.IN.SECT%+2
      THEN RIGHTLENGTH%=1
      ELSE RIGHTLENGTH%=2
740 GOSUB 11200 : IF ERRFLAG%=0 THEN 760
750 GOSUB 11500 : GOTO 730 :'BAD DATUM$
760 Q%=QUESTION%-FIRST.Q.IN.SECT%+1 :
      ON Q% GOTO 770,770,810
770 'IN DOOR AND CUT-IN TEMPERATURES
780 GOSUB 11300 : IF ERRFLAG%>0 THEN 750
790 R1%=5 : R2%=30 : T%=VAL(DATUM$) :
      GOSUB 10200 : IF ERRFLAG%>0 THEN 750
      ELSE DATUM$=RIGHT$(STR$(T%),2)
800 ANSWER$(QUESTION%)=DATUM$ : GOTO 690
810 'AUTO SET-BACK DEVICE
820 IF DATUM$<>"0" AND DATUM$<>"1"
      THEN 750
      ELSE 800
830 GOSUB 11600 : IF VERIFY$<>"" THEN 710
```

```
900 '************************************************
910 'SECTION 14 -- WATER -- DATUM 300-303
920 SECTOR%=14 : FIRST.Q.IN.SECT%=300 :
       Q.IN.SECT%=4 : GOSUB 12000
930 DATA HOT WATER TEMPERATURE
940 DATA FLOW RESTRICTOR SUITABILITY--KITCHEN SINK
950 DATA F.R.S.--SHOWER,F.R.S.--BATHROOM SINK
960 SECTION$(SECTOR%)="DOMESTIC HOT WATER"
970 GOSUB 11900 :'BUMP QUESTION
980 IF QUESTION%=FIRST.Q.IN.SECT%+Q.IN.SECT%
       THEN 1090 :'VERIFY
990 GOSUB 11400 :'GET DATUM$
1000 LCODE%=1 : IF QUESTION%=300
       THEN RIGHTLENGTH%=2
       ELSE RIGHTLENGTH%=1
1010 GOSUB 11200 : IF ERRFLAG%=0 THEN 1030
1020 GOSUB 11500 : GOTO 1010 :'BAD DATUM$
1030 Q%=QUESTION%-FIRST.Q.IN.SECT%+1 :
       ON Q% GOTO 1040,1080,1080,1080
1040 'WATER TEMP.
1050 GOSUB 11300 : IF ERRFLAG%>0 THEN 1020
1060 IF VAL(DATUM$)<30 OR VAL(DATUM$)>99
       THEN 1020
1070 ANSWER$(QUESTION%)=DATUM$ : GOTO 970
1080 IF DATUM$<"0" OR DATUM$>"1"
       THEN 1020
       ELSE 1070
1090 GOSUB 11600 : IF VERIFY$<>"" THEN 990
```

```
1200 '************************************************
1210 'SECTION 15 -- DIMENSIONS & INSULATION
1220 FOR SECTOR%=15 TO 25 :
        READ SECTION$(SECTOR%) :
        NEXT SECTOR%
1230 DATA MAIN WALL,ADDED WALL,KNEE WALL
1240 DATA EXPOSED FLOOR,MAIN ATTIC,ADDED ATTIC
1250 DATA SLOPED ATTIC,FLAT ROOF,FOUNDATION,ADDED FOUNDATION
1260 DATA BASEMENT FLOOR
1270 KON%=290 : Q.IN.SECT%=2
1280 FOR SECTOR%=15 TO 25 :
        KON%=KON%+20
1290 'DIMENSIONS
1300 FOR EL%=KON% TO KON%+8 STEP 2
1310 FIRST.Q.IN.SECT%=EL%
1320 QUE$(EL%)="PERIMETER/LENGTH ( <RETURN> IF NO MORE )" :
        QUE$(EL%+1)="WIDTH/HEIGHT" :
        LYNE%=20 : VERIFY%=0
1330 QUESTION%=EL%-1
1340 GOSUB 11900 :'BUMP QUESTION
1350 IF QUESTION%=EL%+2 THEN 1460 :'VERIFY
1360 GOSUB 11400 :'GET DATUM$
1370 IF DATUM$<>"" THEN 1400
1380 IF QUESTION%=EL% THEN 1480 :'DONE-ADVANCE
1390 GOSUB 11500 : GOTO 1370 :'BAD DATUM$
1400 LCODE%=1 : IF KON%<370
     AND QUESTION%=EL%+1 THEN
     RIGHTLENGTH%=2 ELSE
     RIGHTLENGTH%=3
1410 GOSUB 11200 : IF ERRFLAG%>0 THEN 1390
1420 GOSUB 11300 : IF ERRFLAG%>0 THEN 1390
1450 ANSWER$(QUESTION%)=DATUM$ : GOTO 1340
1460 GOSUB 11600 : IF VERIFY$<>"" THEN 1360
1470 NEXT EL%
1480 'INSULATION
1490 IF SECTOR%=25 THEN 1920 :'BSMNT FLOOR NO INSULATION
1500 IF DATUM$="" AND EL%=KON% THEN 1920
1510 FOR EL%=KON%+10 TO KON%+14 STEP 2
1520 FIRST.Q.IN.SECT%=EL%
1530 QUE$(EL%)="EXISTING INSULATION TYPE ( <RET> IF NO MORE )"
1540 QUE$(EL%+1)="EXISTING INSULATION THICKNESS" :
        LYNE%=20 : VERIFY%=0
1550 QUESTION%=EL%-1
1560 GOSUB 11900 :'BUMP QUESTION
1570 IF QUESTION%=EL%+2 THEN 1710 :'DONE--VERIFY
1580 GOSUB 11400 :'GET DATUM$
1590 IF DATUM$<>"" AND DATUM$<>"0" THEN 1620
1600 IF QUESTION%=EL% THEN 1730 :'DONE--ADVANCE
1610 GOSUB 11500 : GOTO 1590 :'BAD DATUM$
1620 Q%=QUESTION%-EL%+1 : LCODE%=1 :
        IF Q%=1 THEN RIGHTLENGTH%=1
        ELSE RIGHTLENGTH%=3
1630 GOSUB 11200 : IF ERRFLAG%>0 THEN 1610
1640 GOSUB 11300 : IF ERRFLAG%>0 THEN 1610
1650 ON Q% GOTO 1660,1680
1660 IF DATUM$<"1" OR DATUM$>"3" THEN 1610
1670 ANSWER$(QUESTION%)=DATUM$ : GOTO 1560
```

```
1680 'SET MIN & MAX INSULATION THICKNESSES
1690 'EDIT HERE
1700 GOTO 1670
1710 GOSUB 11600 : IF VERIFY$<>"" THEN 1580
1720 NEXT EL%
1730 'POTENTIAL INSULATION
1740 FIRST.Q.IN.SECT%=KON%+16
1750 QUE$(FIRST.Q.IN.SECT%)="POTENTIAL INSULATION TYPE"
1760 QUE$(FIRST.Q.IN.SECT%+1)="POTENTIAL INSULATION THICKNESS"
1770 QUESTION%=FIRST.Q.IN.SECT%-1 :
        LYNE%=20 : VERIFY%=0
1780 GOSUB 11900 :'BUMP QUESTION%
1790 IF QUESTION%=FIRST.Q.IN.SECT%+Q.IN.SECT%
        THEN 1910 :'VERIFY
1795 IF DATUM$<"1" AND
     QUESTION%=FIRST.Q.IN.SECT%+1 THEN 1910
1800 GOSUB 11400 :'GET DATUM$
1810 Q%=QUESTION%-FIRST.Q.IN.SECT%+1 :
        IF DATUM$="0" AND Q%=1 THEN 1910 :'DONE--VERIFY
1820 LCODE%=1 : IF Q%=1 THEN RIGHTLENGTH%=1
        ELSE RIGHTLENGTH%=3
1830 GOSUB 11200 : IF ERRFLAG%=0 THEN 1850
1840 GOSUB 11500 : GOTO 1830 :'BAD DATUM$
1850 GOSUB 11300 : IF ERRFLAG%>0 THEN 1840
1860 ON Q% GOTO 1870,1890
1870 IF DATUM$<"0" OR DATUM$>"3" THEN 1840
1880 ANSWER$(QUESTION%)=DATUM$ : GOTO 1780
1890 'EDIT THICKNESSES HERE
1900 GOTO 1880
1910 GOSUB 11600 : IF VERIFY$<>"" THEN 1800
1920 NEXT SECTOR%
2000 'FOUNDATION HEIGHT ABOVE GRADE/INSULATION DEPTH
                                DATUM 520-523
2010 SECTOR%=25 : FIRST.Q.IN.SECT%=520 :
        Q.IN.SECT%=4 : GOSUB 12000
2020 DATA FOUNDATION WALL HEIGHT ABOVE GRADE
2021 DATA FOUNDATION WALL DEPTH OF INSULATION
2022 DATA ADDED FOUNDATION WALL HEIGHT ABOVE GRADE
2023 DATA ADDED FOUNDATION WALL DEPTH OF INSULATION
2030 SECTION$(SECTOR%)="FOUNDATION HEAT LOSS"
2040 GOSUB 11900 :'BUMP QUESTION
2050 IF QUESTION%=520 AND ANSWER$(470)="" THEN QUESTION%=522
2055 IF QUESTION%=522 AND ANSWER$(490)="" THEN 2090
2060 IF QUESTION%=FIRST.Q.IN.SECT%+Q.IN.SECT%
        THEN 2090 :'VERIFY
2070 GOSUB 11400 :'GET DATUM$
2080 ANSWER$(QUESTION%)=DATUM$ :
        GOTO 2040
2090 GOSUB 11600 : IF VERIFY$<>"" THEN 2070
```

```
2300 '***********************************************
2310 'END OF PAGE 2 -- DUMP DATA TO DISC B
       MAKE ROOM FOR PAGE 3
2320 GOSUB 12100
2330 FOR QUESTION%=201 TO 549 :
       PRINT#1,ANSWER$(QUESTION%) :
       NEXT QUESTION%
2340 CHAIN MERGE "AUDIT3.SJ4",,ALL,DELETE 10-2340
```

```
5 COMMON FILENAME$
10 'AUDIT3 - AUDIT3 - AUDIT3 - AUDIT3
       WHISTLE
20 FOR L%=1 TO 250 : PRINT CHR$(&H7); : NEXT L%
50 '***********************************************
60 'SECTION 25 -- MAINTENANCE FLAGS -- DATUM 550-554
70 SECTOR%=25 : FIRST.Q.IN.SECT%=550 :
       Q.IN.SECT%=5 : GOSUB 12000
80 DATA BASEMENT,FIRST FLOOR
90 DATA INTERMEDIATE FLOOR(S)
100 DATA TOP FLOOR,ATTIC
110 SECTION$(SECTOR%)="MAINTENANCE"
120 GOSUB 11900 :'BUMP QUESTION
130 IF QUESTION%=FIRST.Q.IN.SECT%+Q.IN.SECT%
       THEN 240 :'VERIFY
140 GOSUB 11400 :'GET DATUM$
150 LCODE%=2 : RIGHTLENGTH%=9
160 GOSUB 11200 : IF ERRFLAG%=0 THEN 180
170 GOSUB 11500 : GOTO 150 :'BAD DATUM$
180 GOSUB 11300 : IF ERRFLAG%>0 THEN 170
190 'LOOP TO EDIT STRING -- TRIP OUT IF NULL
       VALID ENTRIES 1-9 -- LEFT JUSTIFIED
200 'ADD ROUTINE TO CATCH REPEATS LATER
210 IF LENGTHLINE%=0 THEN  120
220 FOR L%=1 TO LENGTHLINE% :
       C$=MID$(DATUM$,L%,1) :
       IF C$<"1" OR C$>"9" THEN 170
       ELSE NEXT L%
230 ANSWER$(QUESTION%)=DATUM$ : GOTO 120
240 GOSUB 11600 : IF VERIFY$<>"" THEN 140
```

```
330 '***************************************************
340 'SECTION 24 -- DOMESTIC HOT WATER -- DATUM 600-604
350 SECTOR%=24 : FIRST.Q.IN.SECT%=600 :
        Q.IN.SECT%=5 : GOSUB 12000
360 DATA TYPE OF WATER HEATER,CAPACITY
370 DATA CONDITION,INSULATION,CLEARANCE
380 SECTION$(SECTOR%)="DOMESTIC HOT WATER"
390 GOSUB 11900 :'BUMP QUESTION%
400 IF QUESTION%=FIRST.Q.IN.SECT%+Q.IN.SECT%
        THEN 570 :'VERIFY
410 IF QUESTION%>600 AND ANSWER$(600)="0" THEN 390
420 IF QUESTION%>600 AND ANSWER$(600)="1"
        AND QUESTION%<>602 THEN 390
430 GOSUB 11400 :'GET DATUM$
440 IF QUESTION%=600 THEN LCODE%=4
        ELSE LCODE%=1
450 IF QUESTION%=601 THEN RIGHTLENGTH%=3
        ELSE IF QUESTION%=603 THEN RIGHTLENGTH%=2
        ELSE RIGHTLENGTH%=1
460 GOSUB 11200 : IF ERRFLAG%=0 THEN 480
470 GOSUB 11500 : GOTO 440 :'BAD DATUM$
480 Q%=QUESTION%-FIRST.Q.IN.SECT%+1 :
        ON Q% GOTO 490,530,530,530,530
490 IF DATUM$="0" OR DATUM$="" THEN 570 :'VERIFY
500 'NOTE - FUTURE CHANGE - ? 0 OR NULL VERIFY RESPONSE
510 IF DATUM$<"1" OR DATUM$>"6" THEN 470
520 ANSWER$(QUESTION%)=DATUM$ : GOTO 390
530 GOSUB 11300 : IF ERRFLAG%>0 THEN 470
540 IF QUESTION%=601 THEN MIN%=1
        ELSE MIN%=0
550 IF QUESTION%=601 THEN MAX%=200
        ELSE IF QUESTION%=603 THEN MAX%=99
        ELSE MAX%=1
560 IF VAL(DATUM$)<MIN% OR VAL(DATUM$)>MAX%
        THEN 470
        ELSE 520
570 GOSUB 11600 : IF VERIFY$<>"" THEN 430
```

```
600 '************************************************
603 'SECTION 25 -- INSPECTION -- DATUM 605-609
606 'DATA NOT EDITED AT ALL
609 SECTOR%=25 : FIRST.Q.IN.SECT%=605 :
      Q.IN.SECT%=5 : GOSUB 12000
612 DATA OIL LINES,FLUE PIPE,BARO
613 DATA SEALS,DUCTS
616 SECTION$(SECTOR%)="INSPECTION"
620 GOSUB 11900 :'BUMP QUESTION%
623 IF QUESTION%=FIRST.Q.IN.SECT%+Q.IN.SECT%
      THEN 635 :'VERIFY
626 GOSUB 11400 :'GET DATUM$
630 ANSWER$(QUESTION%)=DATUM$ : GOTO 620
635 GOSUB 11600 : IF VERIFY$<>"" THEN 626
700 '***************************************************
710 'SECTION 25 -- FURNACE BOILER -- DATUM 610-615
720 ' NO DATA EDITING AT ALL!
730 SECTOR%=25 : FIRST.Q.IN.SECT%=610 :
      Q.IN.SECT%=6 : GOSUB 12000
740 DATA TYPE,MANUFACTURER & MODEL NUMBER
750 DATA AGE,BTU IN,BTU OUT,MIN. NOZZLE
760 SECTION$(SECTOR%)="FURNACE/BOILER"
770 GOSUB 11900 :'BUMP QUESTION%
775 IF QUESTION%=611 THEN QUESTION%=612
776 IF QUESTION%=613 THEN QUESTION%=614
780 IF QUESTION%=FIRST.Q.IN.SECT%+Q.IN.SECT%
      THEN 810 :'VERIFY
790 GOSUB 11400 :'GET DATUM$
800 ANSWER$(QUESTION%)=DATUM$ : GOTO 770
810 GOSUB 11600 : IF VERIFY$<>"" THEN 790
1000 '***************************************************
1010 'SECTION 26 -- BURNER -- DATUM 620-625
1020 ' NO DATA EDITING AT ALL!
1030 SECTOR%=26 : FIRST.Q.IN.SECT%=620 :
      Q.IN.SECT%=6 : GOSUB 12000
1040 DATA TYPE,MANUFACTURER & MODEL NUMBER
1050 DATA AGE,NOZZLE SIZE,SOLENOID VALVE,RETENTION HEAD
1060 SECTION$(SECTOR%)="BURNER"
1070 GOSUB 11900 :'BUMP QUESTION%
1075 IF QUESTION%=621 THEN QUESTION%=622
1080 IF QUESTION%=FIRST.Q.IN.SECT%+Q.IN.SECT%
      THEN 1110 :'VERIFY
1090 GOSUB 11400 :'GET DATUM$
1100 ANSWER$(QUESTION%)=DATUM$ :
      GOTO 1070
1110 GOSUB 11600 : IF VERIFY$<>"" THEN 1090
```

```
1300 '**************************************************
1310 'SECTION 27 -- DISTRIBUTOR -- DATUM 630-633
1320 ' NO DATA EDITING AT ALL!
1330 SECTOR%=27 : FIRST.Q.IN.SECT%=630 :
     Q.IN.SECT%=4 : GOSUB 12000
1340 DATA CONTINUOUS CIRCULATION,CUT-IN TEMPERATURE
1350 DATA CUT-OUT TEMPERATURE,VARIABLE AQUASTAT
1360 SECTION$(SECTOR%)="DISTRIBUTOR"
1365 GOTO 1600
1370 GOSUB 11900 :'BUMP QUESTION%
1380 IF QUESTION%=FIRST.Q.IN.SECT%+Q.IN.SECT%
     THEN 1410 :'VERIFY
1390 GOSUB 11400 :'GET DATUM$
1400 ANSWER$(QUESTION%)=DATUM$ :
     IF QUESTION%=630 AND DATUM$="1"
     THEN 1410
     ELSE 1370
1410 GOSUB 11600 : IF VERIFY$<>"" THEN 1390
1600 '**************************************************
1610 'SECTION 28 -- EFFICIENCY TEST RESULTS  -- DATUM 640-644
1620 ' NO DATA EDITING AT ALL!
1630 SECTOR%=28 : FIRST.Q.IN.SECT%=640 :
     Q.IN.SECT%=6 : GOSUB 12000
1640 DATA SMOKE,CO 2,DRAFT
1650 DATA STACK TEMP.,STEADY STATE EFFICIENCY
1655 DATA DOMESTIC H.W. STEADY ST. EFFICIENCY
1660 SECTION$(SECTOR%)="EFFICIENCY TEST RESULTS"
1670 GOSUB 11900 :'BUMP QUESTION%
1680 IF QUESTION%=FIRST.Q.IN.SECT%+Q.IN.SECT%
     THEN 1710 :'VERIFY
1690 GOSUB 11400 :'GET DATUM$
1700 ANSWER$(QUESTION%)=DATUM$ :
     GOTO 1670
1710 GOSUB 11600 : IF VERIFY$<>"" THEN 1690
1900 '**************************************************
1910 'SECTION 29 -- ROOF & SOFFITS -- DATUM 720-725
1920 ' NO DATA EDITING AT ALL!
1930 SECTOR%=29 : FIRST.Q.IN.SECT%=720 :
     Q.IN.SECT%=6 : GOSUB 12000
1940 DATA SHINGLES,FLASHING,PAINT
1950 DATA GUTTERS,VENTS,CHIMNEY
1960 SECTION$(SECTOR%)="ROOF AND SOFFITS"
1970 GOSUB 11900 :'BUMP QUESTION%
1980 IF QUESTION%=FIRST.Q.IN.SECT%+Q.IN.SECT%
     THEN 2010 :'VERIFY
1990 GOSUB 11400 :'GET DATUM$
2000 ANSWER$(QUESTION%)=DATUM$ :
     GOTO 1970
2010 GOSUB 11600 : IF VERIFY$<>"" THEN 1990
```

```
2200 '*********************************************
2210 'SECTION 30 -- WALLS & WINDOWS -- DATUM 730-734
2220 ' NO DATA EDITING AT ALL!
2230 SECTOR%=30 : FIRST.Q.IN.SECT%=730 :
     Q.IN.SECT%=5 : GOSUB 12000
2240 DATA PEEL,LEAKS,LOOSE STORMS
2250 DATA BROKEN PANES,POOR CAULK
2260 SECTION$(SECTOR%)="WALLS AND WINDOWS"
2270 GOSUB 11900 :'BUMP QUESTION%
2280 IF QUESTION%=FIRST.Q.IN.SECT%+Q.IN.SECT%
     THEN 2310 :'VERIFY
2290 GOSUB 11400 :'GET DATUM$
2300 ANSWER$(QUESTION%)=DATUM$ :
     GOTO 2270
2310 GOSUB 11600 : IF VERIFY$<>"" THEN 2290
2500 '*********************************************
2510 'SECTION 31 -- FOUNDATION & DRAINAGE -- DATUM 740-744
2520 ' NO DATA EDITING AT ALL!
2530 SECTOR%=31 : FIRST.Q.IN.SECT%=740 :
     Q.IN.SECT%=5 : GOSUB 12000
2540 DATA CRACKS,LEAKS,LOOSE MASONRY
2550 DATA STRUCTURAL,POOR SLOPE
2560 SECTION$(SECTOR%)="FOUNDATION AND DRAINAGE"
2570 GOSUB 11900 :'BUMP QUESTION%
2580 IF QUESTION%=FIRST.Q.IN.SECT%+Q.IN.SECT%
     THEN 2610 :'VERIFY
2590 GOSUB 11400 :'GET DATUM$
2600 ANSWER$(QUESTION%)=DATUM$ :
     GOTO 2570
2610 GOSUB 11600 : IF VERIFY$<>"" THEN 2590
```

```
2800 '*************************************************
2810 'SECTION 32 -- FILL PIPE -- DATUM 750-753
2820 ' NO DATA EDITING AT ALL!
2830 SECTOR%=32 : FIRST.Q.IN.SECT%=750 :
        Q.IN.SECT%=4 : GOSUB 12000
2840 DATA SEAL,LEAK
2850 DATA CAP,LOOSE
2860 SECTION$(SECTOR%)="FILL PIPE"
2870 GOSUB 11900 :'BUMP QUESTION%
2880 IF QUESTION%=FIRST.Q.IN.SECT%+Q.IN.SECT%
        THEN 2910 :'VERIFY
2890 GOSUB 11400 :'GET DATUM$
2900 ANSWER$(QUESTION%)=DATUM$ :
        GOTO 2870
2910 GOSUB 11600 : IF VERIFY$<>"" THEN 2890
2920 FOR QUESTION%=550 TO 800 :
        PRINT#1,ANSWER$(QUESTION%) :
        NEXT QUESTION%
2930 CLOSE
2940 ERASE ANSWER$
2950 CHAIN "CRUNCH"
```

```
5 COMMON FILENAME$
 10 'CRUNCH - AUDIT ANALYZER
 20 OPTION BASE 1
 50 IF FILENAME$<>"" THEN 70
 55 LINE INPUT "METER NUMBER: ";FILENAME$
 60 FILENAME$="B:X"+LEFT$(FILENAME$,6)+"."+
        RIGHT$(FILENAME$,3)
 70 OPEN "I",#1,FILENAME$
 80 DIM ANSWER$(800),CHEK$(800)
 90 DIM SUBAREA(13),DCOST(13),PCOST(13),
        OPTRSI(80),RSI(80),LABEL$(80)
 100 DIM SAVINGS(80),DIYCOST(80),PROCOST(80),
        DIYPBACK(80),PROPBACK(80)
 110 FOR L%=1 TO 800 :
        LINE INPUT#1,ANSWER$(L%) :
        NEXT L%
 111 CLOSE : J%=0 : PRINT CHR$(&H1A);
     "BEFORE I PROCEED WITH DATA ANALYSIS"
 112 PRINT "DO YOU WANT TO:" :
     PRINT "(1) PROCEED" :
     PRINT "(2) DISPLAY AN ANSWER" :
     PRINT "(3) CHANGE AN ANSWER"
 113 INPUT A$ : IF (A$<>"1" AND A$<>"2"
        AND A$<>"3") THEN 112 ELSE
        IF A$="1" THEN 125
 114 INPUT "QUESTION #: ";L% :
     IF L%<1 OR L%>800 THEN 114
 115 IF A$="3" THEN 120
 116 PRINT CHR$(&H1A);"ANSWER ";L%;" IS ";
        ANSWER$(L%)
 117 FOR L%=1 TO 4000 : NEXT L% :
     PRINT CHR$(&H1A) : GOTO 112
 120 J%=1 : PRINT CHR$(&H1A);
        "OLD ANSWER ";L%;" WAS ";ANSWER$(L%) :
   PRINT "NEW ANSWER ";L%;"  IS "; :
   LINE INPUT ANSWER$(L%)
 121 PRINT CHR$(&H1A) : GOTO 112
 125 IF J%=0 THEN 140 ELSE
     PRINT CHR$(&H1A);"DO YOU WANT NEW DATA VALUES"
 126 PRINT "STORED ON DISC"
 127 INPUT "(0) NO; (1) YES";AAS$
```

```
140 DIM OPENING(4,3)
150 DIM A(4,5) : FOR A%=1 TO 4 : FOR D%=1 TO 5 :
        READ A(A%,D%) : NEXT D% : NEXT A%
160 DATA 232,58,33,11,7,215,53,21,10,6
170 DATA 305,76,44,15,7,541,135,77,27,17
180 FOR L%=1 TO 5 : READ WC%(L%) : NEXT L%
190 DATA 50,60,75,90,110
300 '
310 'ENVELOPE AREA
        BY SUBAREAS FIRST
320 LC%=0
330 FOR L%=310 TO 510 STEP 20
340 LC%=LC%+1
350 FOR M%=L% TO L%+8 STEP 2
360 SUBAREA(LC%)=(VAL(ANSWER$(M%))/10)
        *(VAL(ANSWER$(M%+1))/10)
        +SUBAREA(LC%)
370 NEXT M%
375 PRINT CHR$(&H1A);"THINKING 375";L%
380 TOT.ENV.AREA=TOT.ENV.AREA
        +SUBAREA(LC%)
390 NEXT L%
```

```
500 '
510 'DECREMENT SUB AREAS BY WINDOWS AND DOORS
         S-M-L WINDOW AREAS .5-1-1.5
         ALL DOORS - 2
520 FOR L%=201 TO 268 :
         IF ANSWER$(L%)="" THEN 630
530 IF L%>200 AND L%<221 THEN AREA = .5
         ELSE IF L%>220 AND L%<241 THEN AREA=1
         ELSE IF L%>240 AND L%<261 THEN AREA =1.5
         ELSE IF L%>260 AND L%<269 THEN AREA=2
540 'SINGLE WINDOW AND DOOR COUNT AND AREA
         FOR SAVINGS/COST/PAYBACK LATER
550 IF MID$(ANSWER$(L%),2,1)>"1" THEN 580
560 IF AREA<2 THEN SNGLWNDO%=SNGLWNDO%+1
         ELSE SNGLDOOR%=SNGLDOOR%+1
570 IF AREA<2 THEN
         SUBAREA(12)=SUBAREA(12)+AREA ELSE
         SUBAREA(13)=SUBAREA(13)+AREA
580 LC%=VAL(MID$(ANSWER$(L%),1,1)) :
         SUBAREA(LC%)=SUBAREA(LC%)-AREA
590 '
600 'TOTAL WINDOW AND DOOR AREA
         BY TYPE ACROSS
         BY GLAZING DOWN
610 TYPE%=AREA*2 : GLAZING%=VAL(MID$(ANSWER$(L%),2,1))
620 OPENING(TYPE%,GLAZING%)=OPENING(TYPE%,GLAZING%)
         +AREA
630 NEXT L%
650 PRINT "THINKING 650"
700 '
710 'CONDUCTIVE LOSS CALCULATION
         WINDOWS AND DOORS FIRST
720 'ASSUMED RSI'S WINDOWS .15 - .35 - .50
         DOORS .5 - .7 - .7
730 CONDLOSS=0
740 FOR TYPE%=1 TO 4 :
         FOR GLAZING%=1 TO 3
750 IF TYPE%=4 THEN 780
760 IF GLAZING%=1 THEN RSI =.15
         ELSE IF GLAZING%=2 THEN RSI=.35
         ELSE RSI = .5
770 GOTO 790
780 IF GLAZING%=1 THEN RSI=.5
         ELSE RSI=.7
790 CONDLOSS=CONDLOSS+OPENING(TYPE%,GLAZING%)/RSI
800 NEXT GLAZING% :
         NEXT TYPE%
```

```
810 '
812 BSMTTMP%=VAL(ANSWER$(36)) :
    HTABVGRD(9)=VAL(ANSWER$(520))/10 :
    HTABVGRD(10)=VAL(ANSWER$(522))/10
815 PRINT "THINKING 815"
820 'NOW SUBAREAS
        DERIVE RSI OF EACH
830 'ASSUMED RSI/MM  1-BATTS(1.55/89)
                     2-LOOSE(1.55/89)
                     3-BOARD(.031)
840 L%=300
841 'BASEMENT FLOOR OR SLAB RSI VALUE
842 IF ANSWER$(26)="3" THEN RSI(11)=4
                         ELSE RSI(11)=7
843 IF BSMTTMP%<=15 AND ANSWER$(26)="1"
                         THEN RSI(11)=100
850 FOR LC%=1 TO 11 : L%=L%+20 :
        IF SUBAREA(LC%)=0 THEN 999
855 IF LC%<9 THEN RSI(LC%)=.7 :'BASE VALUE UNINSULATED AREA
857 IF LC%=3 OR LC%=5 OR LC%=6
        THEN RSI(LC%)=.2
870 IF LC%=11 THEN 940
880 FOR M%=L% TO L%+4 STEP 2
890 IF ANSWER$(M%)="" THEN 930 :'NEXT M%
900 TYPE%=VAL(ANSWER$(M%)) :
        THICK%=VAL(ANSWER$(M%+1))
910 IF TYPE%=1 THEN RSI=1.55/89
        ELSE IF TYPE%=2 THEN RSI=1.55/89
        ELSE RSI=.031
920 RSI(LC%)=RSI(LC%)+RSI*THICK%
930 NEXT M%
935 IF LC%=9 OR LC%=10 THEN 942
940 IF RSI(LC%)>0 THEN
        CONDLOSS=CONDLOSS+SUBAREA(LC%)/RSI(LC%)
941 GOTO 999
942 'CONDUCTIVE LOSSES THROUGH BASEMENT WALL
943 IF RSI(LC%)>0 THEN 945
944 KO(LC%)=1 : GOTO 948 :'KO()=1=UNINSULATED WALL
945 IF (LC%=9 AND VAL(ANSWER$(521))=
        VAL(ANSWER$(471))) OR (LC%=10   AND VAL(ANSWER$(523))=VAL(ANSWER$(491))
        THEN 947
946 KO(LC%)=2 : GOTO 948 :'KO()=2=PARTIALLY INS. WALL
947 KO(LC%)=3 :'KO()=3=FULLY INSULATED WALL
948 S=SUBAREA(LC%)*1.42*(BSMTTMP%/18)
949 ON KO(LC%) GOTO 950,955,960
950 CLOSS(LC%-2)=S*1.1*(.4+((.6*HTABVGRD(LC%)*1000)/460))
951 GOTO 965
955 CLOSS(LC%-2)=S*1.05*(.81+.19*HTABVGRD(LC%)*1000/460)*
        (.319+.681/(1+RSI(LC%)/.391))
956 GOTO 965
960 CLOSS(LC%-2)=S*(.73+.27*HTABVGRD(LC%)*1000/460)*
        (.095+.905/(1+RSI(LC%)/.37))
965 CONDLOSS=CONDLOSS+CLOSS(LC%-2)
972 IF KO(LC%)=3 THEN 999
974 CLOSS(LC%)=S*1*(.73+.27*HTABVGRD(LC%)*1000/460)*
        (.095+.905/(1+1.55/.37))
999 NEXT LC%
```

```
1000 '
1010 'AIR CHANGE RATE
1020 'MOISTURE RATING
1030 OCCUPANTS%=VAL(ANSWER$(27)) :
        IF OCCUPANTS%>4 THEN M%=3
        ELSE IF OCCUPANTS%>2 THEN M%=2
        ELSE M%=1
1040 OCCUPANTLVL%=M%
1050 BSMTHUM%=VAL(ANSWER$(51))+1
1060 M%=M%+BSMTHUM% :
        IF BSMTTMP%>15 AND BSMTHUM%=2 THEN M%=M%+1
1070 CDRYING%=VAL(ANSWER$(52))+1 :
        M%=M%+CDRYING%
1080 HMDFRUSE%=VAL(ANSWER$(53))+1 :
        M%=M%+HMDFRUSE%
1090 IF M%>8 THEN MOISTURE%=3
        ELSE IF M%>5 THEN MOISTURE%=2
        ELSE MOISTURE%=1
1100 HUMLVL%=VAL(ANSWER$(54))+1
1110 IF HUMLVL%=3 THEN ACE=.2+MOISTURE%/10
        ELSE IF HUMLVL%=2 THEN ACE=.4+MOISTURE%/10
        ELSE ACE=.6+MOISTURE%/10
1120 IF ANSWER$(37)="1" THEN ACE=ACE*1.5 :'EXPOSURE EXTREME
1130 '
1135 PRINT "THINKING 1135"
1140 'AVERAGE BUILDING TEMP
1150 AVGTMP=(VAL(ANSWER$(31))+VAL(ANSWER$(32))+
        VAL(ANSWER$(33))) / 3
1160 'CORRECTED FOR CUT-IN ERROR
1170 INDOOR=VAL(ANSWER$(280)) : CUTIN=VAL(ANSWER$(281)) :
    IF INDOOR>CUTIN THEN TSTATERR=INDOOR-CUTIN
    ELSE TSTATERR=(-1)*(CUTIN-INDOOR)
1180 AVGTMP=AVGTMP+TSTATERR
1300 '
1310 'ENVELOPE INDEX
        FUNCTION OF Q.23 AND Q.25
1320 N23%=VAL(ANSWER$(23)) : N25%=VAL(ANSWER$(25))
1330 ENVINDEX=1.06 :
        IF N23%=20 THEN ENVINDEX=1.02 :'2 STOREY
1340 IF (N23%=20 AND N25%=2)
        OR N23%=5 THEN ENVINDEX=1.16 :
        'L-SHAPED 2-STOREY OR SPLIT LEVEL
1350 IF (N23%=10 AND N25%=2)
        THEN ENVINDEX=1.2 :'L-SHAPED 1-STOREY
1360 '
1370 'AIR CHANGE LOSS
1380 ACLOSS=(ACE*1300*((TOT.ENV.AREA/(ENVINDEX*6))^1.5))/3600
1381 PRINT "THE PREDICTED AIR CHANGE/ HOUR =",ACE
1390 '
```

```
1400 'HEATING LOAD
1410 HTNGLOAD=ACLOSS+CONDLOSS
1420 '
1425 PRINT "THINKING 1425"
1430 'HEATING COST ANALYSIS
1440 COSTOIL83=.363 :'<---<< $ COST OF 1L OIL IN '82/'83
1450 EFFICIENCY=VAL(ANSWER$(644))/10
1460 '
1470 'FREE HEAT ESTIMATE
1480 FACTR%=OCCUPANTLVL%+VAL(ANSWER$(38))
1490 FREEHEAT%=WC%(FACTR%)
1500 '
1510 'CALCULATED HEATING COST
1515 IF EFFICIENCY=0 THEN EFFICIENCY=75
1520 CLCLITERS=(HTNGLOAD-FREEHEAT%)*86400!
         *(4804+(AVGTMP-14)*169)
         /3.7E+07*100
         /(EFFICIENCY-10)
1530 CLCHC=CLCLITERS*COSTOIL83
1534 FUEL=VAL(ANSWER$(70)) : FF(1)=1 : FF(2)=1.53/1.46 :
         FF(3)=1.36/1.46 : FF(4)=.5 : FF(5)=1 : FF(6)=1
1537 CLCHC=CLCHC*FF(FUEL)
1540 IF ANSWER$(71)>"0" THEN 1560
1550 OILHTCOST=CLCHC :
         GOTO 2210
1560 ON VAL(ANSWER$(71)) GOTO 1700,1733,1770
1700 'HOMEOWNER'S ESTIMATE
1710 COSTOIL=.3 :'1981/'82 COST
1720 OILHTCOST=VAL(ANSWER$(75))
1721 IF ANSWER$(70)="3" THEN 1731
1725 OILHTCOST=COSTOIL83/COSTOIL*OILHTCOST
1730 GOTO 2210
1731 OILHTCOST=1.12*OILHTCOST:GOTO 2210:' 1.12
     IS ELECTRIC INFLATION FACTOR
     FOR 1982-83
1733 'YEARLY CONSUMPTION FROM RECORDS
1736 DATE$(1)=ANSWER$(73)
1739 FOR Q%=76 TO 94 STEP 3 :
     DATE$=ANSWER$(Q%) :
     IF DATE$="" THEN 1748
1742 DATE$(2)=DATE$ :
     OILUSED=OILUSED+VAL(ANSWER$(Q%+1)) :
     DOLLARS=DOLLARS+VAL(ANSWER$(Q%+2))
1745 NEXT Q%
1748 GOSUB 10309 : DAYS=ELAPSED.DAYS%
1750 DATE$(1)=ANSWER$(Q%-6) : GOSUB 10309
1752 UPERD=VAL(ANSWER$(Q%-2))/ELAPSED.DAYS% :
     DPERD=VAL(ANSWER$(Q%-1))/ELAPSED.DAYS%
1755 OILUSED=OILUSED+((365-DAYS)*UPERD) :
     DOLLARS=DOLLARS+((365-DAYS)*DPERD)
1760 IF ANSWER$(70)="3" THEN 1761 ELSE 1765
1761 COSTOIL=DOLLARS/OILUSED:
     OILHTCOST=.0524/COSTOIL*OILHTCOST:
     GOTO 2210:'OIL IS ACTUALLY KWH FOR
     CALCULATION
1762 ' 0.0524 IS DOLLARS/KWH FOR 1982-83
1765 COSTOIL=DOLLARS/OILUSED :
     OILHTCOST=COSTOIL83/COSTOIL*DOLLARS :
     GOTO 2210
```

```
1770 'LITERS/DD METHOD
1780 OPEN "R",#2,"SJNDAYC.DAT",8
1790 FIELD #2,8 AS DEGDAY$
1800 '
1810 'START OIL RECORDS - FIRST IS REF FOR DEG DAYS
1820 DATE$(1)="760101"
1830 DATE$(2)=ANSWER$(73) : GOSUB 10309
1840 REC%=DAY.YEAR%(2) : IF NUM.YEAR%(2)=80
         THEN REC%=REC%-258 ELSE
         IF NUM.YEAR%(2)=82 THEN REC%=REC%+321
1850 IF NUM.YEAR%(2)=81 AND DAY.YEAR%(2)<106
         THEN REC%=REC%+108
1860 IF NUM.YEAR%(2)=81 AND DAY.YEAR%(2)>257
         THEN REC%=REC%-44
1870 GET #2,REC%
1880 DEGDAY1=CVD(DEGDAY$)
1950 '
1955 PRINT "THINKING 1955"
1956 'SECOND(TO ALL) RECORD
1958 FOR L%=76 TO 94 STEP 3 :
     IF ANSWER$(L%)=""THEN 1975
1966 OILUSED=OILUSED+VAL(ANSWER$(L%+1)) :
     DOLLARS=DOLLARS+VAL(ANSWER$(L%+2))
1968 NEXT L%
1975 L%=L%-3 : DATE$(2)=ANSWER$(L%) : GOSUB 10309
1980 REC%=DAY.YEAR%(2) : IF NUM.YEAR%(2)=80
         THEN REC%=REC%-258 ELSE
         IF NUM.YEAR%(2)=82 THEN REC%=REC%+321
1990 IF NUM.YEAR%(2)=81 AND DAY.YEAR%(2)<106
         THEN REC%=REC%+108
2000 IF NUM.YEAR%(2)=81 AND DAY.YEAR%(2)>257
         THEN REC%=REC%-44
2010 GET #2,REC%
2020 DEGDAY2=CVD(DEGDAY$)
2030 DDINPERIOD=DEGDAY2-DEGDAY1
2040 OILPERDD=OILUSED/DDINPERIOD
2060 COSTOIL=DOLLARS/OILUSED
2070 OILHTCOST=4804/DDINPERIOD*DOLLARS
2071 IF ANSWER$(70)="3" THEN 2072 ELSE 2075
2072 OILHTCOST=.0524/COSTOIL*OILHTCOST:
     GOTO 2210 :'OIL IS ACTUALLY KWH FOR
     CALCULATION
2073 ' 0.0524 IS DOLLARS/KWH FOR 1982-83
2075 OILHTCOST=COSTOIL83/COSTOIL*OILHTCOST
```

```
2200 '
2210 'DHW COST CALCULATION
2220 IF ANSWER$(600)<"1" OR ANSWER$(600)>"4"
        THEN 2500 :'RUN AWAY! RUN AWAY! NOT OIL,
                    PROPANE, OR ELECTRIC
2240 'COMPUTE DHW HEATING $
2250 'DAILY USE PER PERSON
2260 DHWUSED%=20 : IF ANSWER$(41)="1"
        THEN DHWUSED%=DHWUSED%+15
2270 IF ANSWER$(42)="1" THEN DHWUSED%=DHWUSED%+10
2280 B%=VAL(ANSWER$(43)) : S%=VAL(ANSWER$(44)) :
        B%=B%/OCCUPANTS% : S%=S%/OCCUPANTS% :
        DHWUSED%=DHWUSED%+B%*9+S%*6
2290 IF ANSWER$(600)="2" THEN RCF = 1.36
        ELSE IF ANSWER$(600)="3" THEN RCF=1.53
        ELSE RCF=1.46
2350 '
2355 PRINT "ALMOST DONE"
2360 'HEATING FACTOR - HEATFCTR
2370 DHWTMP=VAL(ANSWER$(300))
2380 IF DHWTMP>67 THEN HEATFCTR=1 ELSE
        IF DHWTMP>62 THEN HEATFCTR=.9 ELSE
        IF DHWTMP>57 THEN HEATFCTR=.8 ELSE
        IF DHWTMP>52 THEN HEATFCTR=.7 ELSE HEATFCTR=.6
2400 '
2410 REPLACOST=DHWUSED%*OCCUPANTS%*RCF*HEATFCTR
2415 IF ANSWER$(600)="1" THEN 2470
2420 INSUL%=VAL(ANSWER$(603)) : CAPACITY%=VAL(ANSWER$(601))
2430 IF INSUL%>87 THEN D%=5 ELSE
        IF INSUL%>62 THEN D%=4 ELSE
        IF INSUL%>37 THEN D%=3 ELSE
        IF INSUL%>12 THEN D%=2 ELSE D%=1
2440 IF (ANSWER$(600)="2" AND CAPACITY%>50) THEN A%=4
  ELSE IF (ANSWER$(600)="2" AND CAPACITY%>30) THEN A%=3
  ELSE IF (ANSWER$(600)="2" AND CAPACITY%>0) THEN A%=2
        ELSE A%=1
2450 SLCFCTR=A(A%,D%)
2460 SBYCOST=SLCFCTR*HEATFCTR
2470 DHWCOST=REPLACOST+SBYCOST
2480 IF ANSWER$(71)="0" THEN 2500
2485 IF ANSWER$(600)<>"1" AND ANSWER$(600)<>"4"
        THEN 2500
2487 IF DHWCOST>OILHTCOST THEN DHWCOST=OILHTCOST
2490 IF ANSWER$(71)<"3" THEN OILHTCOST=OILHTCOST-DHWCOST
        ELSE OILHTCOST=OILHTCOST-(DHWCOST*.5)
2500 IF ANSWER$(101)="3" THEN INFLATE=1.12 ELSE
        IF ANSWER$(101)="4" THEN INFLATE=1.12 ELSE
        IF ANSWER$(101)="6" THEN INFLATE=1.12 ELSE
        INFLATE=1.21
2510 SPCHTCOST=OILHTCOST+INFLATE*VAL(ANSWER$(104))
```

```
2600 '
2610 'SAVING-COST-PAY BACK
2620 'IF EXISTING RSI IS 70% OF OPTIMUM SKIP
2630 CON=SPCHTCOST*HTNGLOAD/(HTNGLOAD-FREEHEAT%)
2650 M%=0 : RSI(12)=.15 : RSI(13)=.5
2660 FOR L%=1 TO 13 :
     IF L%=11 THEN 2940 :'SKIP BASEMENT FLOOR
2670 M%=M%+1 :
     READ LABEL$(M%),OPTRSI(M%),DCOST(M%),PCOST(M%)
2680 DATA MAIN WALL,2.1,0,10.76
2690 DATA ADDED WALL,2.1,0,10.76
2700 DATA KNEE WALL,2.1,4.2,8.60
2710 DATA EXPOSED FLOOR,4.6,0,43.6
2720 DATA MAIN ATTIC,6.0,1.2,1.9
2730 DATA ADDED ATTIC,6.0,1.2,1.9
2740 DATA SLOPED ATTIC,2.1,0,28
2745 DATA FLAT ROOF,4.1,0,28
2750 DATA FOUNDATION,2.1,9.7,45.8
2760 DATA ADDED FOUNDATION,2.1,9.7,45.8
2770 DATA STORM WINDOWS,.35,100,130
2780 DATA THERMAL DOORS,1.4,200,267
2790 IF SUBAREA(L%)<=0 THEN 2940
2791 IF L%<9 OR L%>10 THEN 2800
2792 IF KO(L%)=3 THEN 2940
2793 'SAVINGS FOR FOUNDATION
2794 SAVINGS(M%)=(CLOSS(M%-2)-CLOSS(M%))*CON/HTNGLOAD
2795 IF KO(L%)=1 THEN 2820
2796 KO=SUBAREA(L%) : SUBAREA(L%)=SUBAREA(L%)*
         (VAL(ANSWER$(521+((L%-9)*2)))/
          VAL(ANSWER$(471+((L%-9)*20)))) :
'THE ABOVE CALCS AREA OF UNINSULATED WALL
2797 GOTO 2820
2800 IF RSI(L%)>(.7*OPTRSI(M%)) THEN 2940:'NEXT L%
2810 SAVINGS(M%)=CON*SUBAREA(L%)/
         RSI(L%)/HTNGLOAD*(1
         -RSI(L%)/OPTRSI(M%))
2820 ON L% GOTO 2840,2840,2840,2890,2890,2890,2840,
         2840,2840,2840,2840,2840,2840
2830 'WALLS AND SLOPED ATTIC
2840 DIYCOST(M%)=SUBAREA(L%)*DCOST(M%)
2850 PROCOST(M%)=SUBAREA(L%)*PCOST(M%)
2860 IF DCOST(M%)>0 THEN DIYPBACK(M%)
         =DIYCOST(M%)/SAVINGS(M%)
2870 PROPBACK(M%)=PROCOST(M%)/SAVINGS(M%)
2880 IF L%<9 OR L%>10 THEN 2940
2882 'SET SUBAREA OF PARTIALLY INSULATED WALL
         BACK TO TOTAL.
2885 IF KO(L%)=2 THEN SUBAREA(L%)=KO
2886 GOTO 2940
2890 'AREA WHOSE COST ARE FUNC. OF RSI AS WELL AS AREA
2900 DCOST(M%)=DCOST(M%)*(OPTRSI(M%)-RSI(L%))
2910 IF L%=4 THEN 2840
2920 PCOST(M%)=PCOST(M%)*(OPTRSI(M%)-RSI(L%))
2930 GOTO 2840
2940 NEXT L%
```

```
3000 '
3010 'DHW SUMMARY WORKSHEET
3015 PRINT "JUST A FEW SECONDS MORE"
3020 LABEL$(61)="TANK INSULATION" :
     LABEL$(62)="TEMPERATURE SETTING" :
     LABEL$(63)="FLOW RESTRICTORS":
     LABEL$(64)="TANKLESS COIL IN SUMMER"
3030 IF ANSWER$(600)>"0" AND ANSWER$(600)<"5"
         THEN 3060 :'OIL, GAS, OR ELECTRIC
3040 'I AM SORRY BUT YOUR HOT WATER
     HEATING SYSTEM IS NOT OIL, PROPANE
     OR ELECTRIC.  I AM UNABLE TO GIVE
     ADVICE ON YOUR SYSTEM.
3050 GOTO 3360
3060 'COMPUTED DAILY USE (L): DHWUSED%
     MEASURED TEMPERATURE (C): DHWTMP
     COMPUTED ANNUAL COST ($): DHWCOST
3070 IF ANSWER$(600)="1" THEN 3275 : 'CONVERT TO ELECTRIC
         HOT WATER IF TANKLESS COIL
3100 'ACTION: REDUCE TEMP. TO 50 DEGREES C!
3110 IF DHWTMP<=52 THEN 3150
3120 SBCKFCTR=HEATFCTR-.6 :
         SAVINGS(62)=SBCKFCTR*DHWCOST :
         PROPBACK(62)=.00005 :'NO COST BUT NEEDS TO BE <>0
3150 'ACTION: ADD TANK INSULATION!
3160 TNKINSUL=VAL(ANSWER$(603)) :
         IF TNKINSUL>50 THEN 3300 :'AMPLE INSULATION
3170 IF ANSWER$(604)="0" THEN 3300 :'NO CLEARANCE
3180 IF TNKINSUL=0 THEN PROCOST(61)=90
         ELSE PROCOST(61)=60
3185 IF TNKINSUL=0 THEN DIYCOST(61)=30
         ELSE DIYCOST(61)=20
3200 IF ANSWER$(600)="2" THEN 3230 :'ELECTRIC
3210 IF TNKINSUL=0 THEN SAVINGS(61)=152
         ELSE SAVINGS(61)=24
3220 GOTO 3270
3230 IF TNKINSUL=0 GOTO 3260 :'UNINSULATED ELECTRIC
3240 IF CAPACITY%>50 THEN SAVINGS(61)=54  ELSE
     IF CAPACITY%>30 THEN SAVINGS(61)=31  ELSE
     SAVINGS(61)=22
3250 GOTO 3270
3260 IF CAPACITY%>50 THEN SAVINGS(61)=353 ELSE
     IF CAPACITY%>30 THEN SAVINGS(61)=200  ELSE
     SAVINGS(61)=141
3270 PROPBACK(61)=PROCOST(61)/SAVINGS(61) :
     DIYPBACK(61)=DIYCOST(61)/SAVINGS(61):GOTO 3300
3275 RRF =.003*DHWUSED%*90: SSF =25 - 9
3277 SAVINGS(64)=RRF + SSF
3279 PROCOST(64)= 240
3299 PROPBACK(64) = PROCOST(64)/SAVINGS(64)
3300 'ACTION: INSTALL FLOW RESTRICTOR ON SHOWER!
3310 IF ANSWER$(302)="0" THEN 3360 :'NOT SUITABLE
3320 IF S%=0 THEN 3360 :'SHOWER NOT USED
3330 PROCOST(63)=60 : DIYCOST(63)=30
3340 SAVINGS(63)=(S%*6)/DHWUSED%*DHWCOST/2
3350 PROPBACK(63)=PROCOST(63)/SAVINGS(63) :
     DIYPBACK(63)=DIYCOST(63)/SAVINGS(63)
3360 'END OF DHW SUMMARY
```

```
3400 'TOTAL ENVELOPE AREA (M^2): TOT.ENV.AREA
     CONDUCTIVE LOSSES: CONDLOSS
     AIR CHANGE LOSSES: ACLOSS
     HEATING LOAD: HTNGLOAD
3410 'FREEHEAT: FREEHEAT%
     CALCULATED HEATING COST: CLCHC
3420 'OIL HEATING COST ($): OILHTCOST
3430 'TOTAL HEATING COST ($): SPCHTCOST
3440 '
3450 LABEL$(41)="AUTOMATIC THERMOSTAT SETBACK"
3460 '
3470 IF ANSWER$(70)="4" OR ANSWER$(70)="6"
        THEN 3590 :'SKIP IF WOOD OR OTHER
3480 IF ANSWER$(282)="1" THEN 3590 :'DEVICE IN USE
3490 DAYCS%=((VAL(ANSWER$(31))+VAL(ANSWER$(32)))/2)
        +TSTATERR :
     NIGHTCS%=VAL(ANSWER$(33))+TSTATERR :
        IF DAYCS%>20 OR NIGHTCS%>17 THEN 3510
3500 GOTO 3590 :'ALREADY AT MINIMUM
3510 T2=3 :'ST.JOHN'S AVG.WINTER DAY TEMP                  <-------<<<
3520 T3=0 :'ST.JOHN'S AVG.WINTER NIGHT TEMP                <-------<<<
3530 PSD=(1/(AVGTMP-T2))*(16/24)*100 :
     PSN=(1/(AVGTMP-T3))*( 8/24)*100
3540 IF DAYCS%<20 THEN DAYCS%=20
3550 IF NIGHTCS%<17 THEN NIGHTCS%=17
3560 TPS=PSD*(DAYCS%-20)+PSN*(NIGHTCS%-17)
3570 SAVINGS(41)=(TPS/100)*CON
3580 PROCOST(41)=110 :
     PROPBACK(41)=PROCOST(41)/SAVINGS(41)
3590 '
```

```
5000 'SEALING -- WINDOWS CAULK/W'STRIP
5010 'WINDOWS - TOTAL AREA, TOTAL AREA NEEDING SEAL
5020 FOR L%=201 TO 260
5030 I$=MID$(ANSWER$(L%),3,1) : IF I$="" THEN 5060
5040 IF L%>240 THEN AREA=1.5 ELSE
     IF L%>220 THEN AREA=1! ELSE
                    AREA=.5
5050 TOTAL(1)=TOTAL(1)+AREA :
        IF I$="1" THEN TOTAL(2)=TOTAL(2)+AREA
5060 NEXT L%
5070 PERCENT=TOTAL(2)/TOTAL(1) :
        IF PERCENT<=.3 THEN 5120 :'> 70% GOOD
5080 DCOST=7.5 : PCOST=3*DCOST :
        SAVED=.15*PERCENT
5090 SAVINGS(21)=SAVED*CON*ACLOSS/HTNGLOAD
5100 DIYCOST(21)=DCOST*TOTAL(2) :
     PROCOST(21)=PCOST*TOTAL(2)
5110 DIYPBACK(21)=DIYCOST(21)/SAVINGS(21) :
     PROPBACK(21)=PROCOST(21)/SAVINGS(21)
5120 '
5130 'SEALING -- DOORS CAULK/W'STRIP
5140 'DOORS - TOTAL AREA, TOTAL AREA NEEDING SEAL
5150 'PRETTY MUCH THE SAME AS WINDOW ROUTINE
5160 TOTAL(1)=0 : TOTAL(2)=0
5170 FOR L%=261 TO 268
5180 I$=MID$(ANSWER$(L%),3,1) : IF I$="" THEN 5210
5190 AREA=2 : TOTAL(1)=TOTAL(1)+AREA :
     IF I$="1" THEN TOTAL(2)=TOTAL(2)+AREA
5200 NEXT L%
5210 PERCENT=TOTAL(2)/TOTAL(1) :
        IF PERCENT<=.3 THEN 5260 :'>70% GOOD
5220 DCOST=10 : PCOST=24 :
        SAVED=.05*PERCENT
5230 SAVINGS(22)=SAVED*CON*ACLOSS/HTNGLOAD
5240 DIYCOST(22)=DCOST*TOTAL(2) :
     PROCOST(22)=PCOST*TOTAL(2)
5250 DIYPBACK(22)=DIYCOST(22)/SAVINGS(22) :
     PROPBACK(22)=PROCOST(22)/SAVINGS(22)
5260 '
```

```
5400 'SEALING -- BASEMENT, WALLS, & ATTIC
5410 'INFILTRATION RESPONSES - 0=REQUIRES   0% SEAL
                                 1=         50%
                                 2=        100%
5415 TOTAL(1)=0 : TOTAL(2)=0 : N=0
5416 FOR Q%=320 TO 362 STEP 2:CHEK$(Q%)=ANSWER$(Q%):NEXT Q%:
     IF CHEK$(320)="0" THEN 5422 ELSE 5417
5417 IF CHEK$(322)="0" THEN 5422 ELSE 5418
5418 IF CHEK$(340) ="0" THEN 5422 ELSE 5419
5419 IF CHEK$(342)  ="0" THEN 5422 ELSE 5420
5420 IF CHEK$(360)  ="0" THEN 5422 ELSE 5421
5421 IF CHEK$(362)  ="0" THEN 5422 ELSE 5430
5422 AREA(1) = SUBAREA(9) + SUBAREA(10)
5423 IF L%=1 THEN I= VAL(ANSWER$(271)
5424 P=I*.5 : N=N+P:
     TOTAL(2) = TOTAL(2)+P*AREA(1)
5425 GOTO 5480
5430 AREA(1)=SUBAREA(9)+SUBAREA(10) :
     AREA(2)=SUBAREA(1)+SUBAREA(2)+SUBAREA(3) :
     AREA(3)=SUBAREA(5)+SUBAREA(6)+SUBAREA(7)+SUBAREA(4)+
             SUBAREA(8)
5440 FOR L%=1 TO 3
5450 I=VAL(ANSWER$(270+L%))
5460 P=I*.5 : N=N+P :
     TOTAL(1)=TOTAL(1)+AREA(L%) :
     TOTAL(2)=TOTAL(2)+P*AREA(L%)
5470 NEXT L%
5480 IF N=0 THEN 5521 :'NO NEED
5490 DCOST=.2 : PCOST=4*DCOST :
       SAVED=.1*N
5500 SAVINGS(23)=SAVED*CON*ACLOSS/HTNGLOAD
5510 DIYCOST(23)=DCOST*TOTAL(2) :
     PROCOST(23)=PCOST*TOTAL(2)
5520 DIYPBACK(23)=DIYCOST(23)/SAVINGS(23) :
     PROPBACK(23)=PROCOST(23)/SAVINGS(23)
```

```
5521 '
5524 FOR Q%=320 TO 362 STEP 2:CHEK$(Q%)=ANSWER$(Q%):NEXT Q%:
     IF CHEK$(320) ="0" THEN 5530 ELSE 5525
5525 IF CHEK$(322) ="0" THEN 5530 ELSE 5526
5526 IF CHEK$(340) ="0" THEN 5530 ELSE 5527
5527 IF CHEK$(342) ="0" THEN 5530 ELSE 5528
5528 IF CHEK$(360) ="0" THEN 5530 ELSE 5529
5529 IF CHEK$(362) ="0" THEN 5530 ELSE 5600
5530 TOTAL(1)=0 :N=0
5533 AREA(1) = SUBAREA(1)+SUBAREA(2)+SUBAREA(3):
     AREA(2) = SUBAREA(5)+SUBAREA(6)+SUBAREA(7)+
               SUBAREA(8)+SUBAREA(4)
5534 FOR L%=1 TO 2 :I=2
5535 P=I*.5 : N=N+P :
     TOTAL(1)=TOTAL(1) + P*AREA(L%):NEXT L%
5537 SAVED =.1*N
5538 WALLSAVINGS=SAVED*CON*ACLOSS/HTNGLOAD
5539 FOR L%= 1 TO 3
5540 WALLSAVINGS= .6*WALLSAVINGS
5541 IF RSI(L%)>(.7*OPTRSI(L%)) THEN 5548
5542 SAVINGS(L%) = SAVINGS(L%) + WALLSAVINGS
5544 PROCOST(L%) = SUBAREA(L%)*PCOST(L%)
5546 PROPBACK(L%)=PROCOST(L%)/SAVINGS(L%)
5548 NEXT L%
5600 LABEL$(21)="WINDOW WEATHERSTRIP" :
     LABEL$(22)="DOOR WEATHERSTRIP" :
     LABEL$(23)="ENVELOPE CAULKING"
5999 PRINT "ARE  YOU  READY  FOR  THIS  ?"
6000 CHAIN MERGE "CRUNCH2.SJ4"..ALL,DELETE 5-10599
```

```
10299 STOP
10309 ' *****************************
      *******  ELAPSED.SUB *********
      *****************************
10319 ' SUBROUTINE TO COMPUTE ELAPSED DAYS (INCLUSIVE)
      I/P DATE$(1)  FORMAT YYMMDD
          DATE$(2)
10329 ' O/P ELAPSED.DAYS% -- [INCLUSIVE]
      DAY.YEAR%(1&2)-DAY.MONTH%(1&2)-NUM.YEAR%(1&2)
      NUM.MONTH%(1&2)
10339 ' DATE$(N) SHOULD BE PRE-EDITED
      BY EDITDATE.SUB
10349 FOR L%=1 TO 2 :
      DAY.MONTH%(L%)=VAL(RIGHT$(DATE$(L%),2)) :
      NUM.YEAR%(L%)=VAL(LEFT$(DATE$(L%),2))
10379 NUM.MONTH%(L%)=VAL(MID$(DATE$(L%),3,2)) :
      K%=NUM.MONTH%(L%) :
       FACTOR%=0 : YEARS%=0
10389 K%=K%-1 : J%=K%*30 :
      IF K%=1 THEN J%=J%+1 ELSE
      IF K%=2 THEN J%=J%-1 ELSE
      IF K%>4 THEN J%=J%+1
10399 IF K%=7 THEN J%=J%+1 ELSE
      IF K%>7 THEN J%=J%+2
10409 IF K%>9 THEN J%=J%+1 :
      'LEAP YEAR
10419 IF NUM.YEAR%(L%) MOD 4 = 0
      AND K%>1
      THEN J%=J%+1
10429 DAY.YEAR%(L%)=J%+DAY.MONTH%(L%)
10439 NEXT L%
10449 IF NUM.YEAR%(1)>NUM.YEAR%(2) THEN 10479  :
      'DIFFERENT YEARS? -- INPUT ORDER?
10459 IF NUM.YEAR%(1)<>NUM.YEAR%(2) THEN 10549
10469 IF DAY.YEAR%(1)<=DAY.YEAR%(2) THEN 10539 :
      'SAME YEAR -- INPUT ORDER?
       REVERSED! -- SWITCH THEM.
10479 SWAP DATE$(1),DATE$(2)
10489 SWAP DAY.MONTH%(1),DAY.MONTH%(2)
10499 SWAP NUM.YEAR%(1),NUM.YEAR%(2)
10509 SWAP DAY.YEAR%(1),DAY.YEAR%(2)
10529 SWAP NUM.MONTH%(1),NUM.MONTH%(2)
10539 IF NUM.YEAR%(1)=NUM.YEAR%(2) THEN 10589
10549 YEARS%=NUM.YEAR%(2)-NUM.YEAR%(1) :
      'YEARS HAVE ELAPSED
10559 FACTOR%=YEARS%*365 :
      'LEAP YEARS?
10569 FOR L%=0 TO YEARS%-1 :
      IF (NUM.YEAR%(1)+L%) MOD 4 = 0
      THEN FACTOR%=FACTOR% + 1
10579 NEXT L%
10589 ELAPSED.DAYS%=((DAY.YEAR%(2)+FACTOR%)
      -DAY.YEAR%(1)) +1
10599 RETURN
```

```
10 COMMON FILENAME$
20 COUNT=0
30 'CRUNCH2 - AUDIT ANALYZER (CONTINUED)
40 'OIL HEATING ROUTINE
50 'NOZZLE BEFORE RETROFIT - NOZZLE(1)
60 IF ANSWER$(70)<>"1" THEN 2000 :'NOT OIL
70 FOR L%=1 TO 10 :
    READ NOZ(L%) :
    NEXT L%
80 DATA 2.25, 2, 1.75, 1.5, 1.25, 1.1, 1, .85, .75, .65
90 TANKLESS=VAL(ANSWER$(600))
200 BTU.HR.OP=HTNGLOAD*(AVGTMP+14)*3.414*1.15*100/EFFICIENCY:
    NOZZLE(5)=BTU.HR.OP/140000!
210 IF OILPERDD>0 THEN
       NOZZLE(5)=((AVGTMP+14)*OILPERDD*.26*3)/24
220 FOR L%=1 TO 10 :
    IF NOZZLE(5)>NOZ(L%) THEN 230 ELSE
    NEXT L%
230 IF L%>1 THEN L%=L%-1
240 NOZZLE(2)=NOZ(L%)
250 IF TANKLESS=1 AND NOZZLE(2)<.85
    THEN NOZZLE(2)=.85
260 FURNAGE=VAL(ANSWER$(612)) :
    SMOKE=VAL(ANSWER$(640)) :
    STACKTEMP=VAL(ANSWER$(643))
270 FURNACENOZ=VAL(ANSWER$(615))/100 :
    BURNERNOZ=VAL(ANSWER$(623))/100
280 SOLENOID=VAL(ANSWER$(624)) :
    RETHEAD=VAL(ANSWER$(625)) :
    SERVICED=VAL(ANSWER$(72))
290 TYPE=VAL(ANSWER$(610)) :
    NOZZLE(1)=BURNERNOZ
400 IF RETHEAD=1 OR FURNAGE<3 THEN 1260
410 IF FURNAGE>=16 THEN 1040
420 IF SERVICED=1 THEN 440
430 COUNT=COUNT+1 :
    RECODE(COUNT)=1 :'SERVICE UNIT
440 IF SMOKE<2 OR SMOKE>3 THEN 1010
450 IF EFFICIENCY<75 THEN 900
500 'PROCEDURE  A A A A A  A A A A A  A A A A A  A A A
510 IF STACKTEMP<400 THEN 760 :'NO REDUCTION
520 IF BURNERNOZ>0 AND FURNACENOZ>0 THEN 610
530 IF FURNACENOZ>0 THEN 550 :
    'BOTH ARE UNKNOWN
     REC. REDUCE NOZ BUT MAKE NO SIZE SUGGESTION -
     SAVE 3%
540 GOTO 750
```

```
550 'FURNACENOZ ONLY KNOWN -
     REC. REDUCE 1 STOP - SAVE 3%
560 FOR L%=1 TO 10 :
    IF FURNACENOZ>NOZ(L%) THEN 570
    ELSE NEXT L%
570 IF L%=11 THEN L%=10
580 NOZZLE(3)=NOZ(L%) :
    'MINIMUM ALLOWABLE = NOZZLE(2) ALREADY CHECKED
590 IF NOZZLE(3)>=NOZZLE(2) THEN 750 :
    'DOWNSIZING 1 STOP FROM FURNACENOZ TAKE US
     BELOW CALC. MIN. - REC. REDUCE NOZ. BUT MAKE NO SIZE
     SUGGESTION.
600 NOZZLE(3)=0 :
    GOTO 750
610 'CONVENTIONAL DOWNSIZING FROM TABLE CHECKED
     FOR MINIMUMS. IE. .65 (.85 IF TNKLS) AND
     FURNACENOZ-1 STOP AND CALC. MINIMUM FOR
     HEATING LOAD
620 FOR L%=1 TO 10 :
    IF BURNERNOZ>NOZ(L%) AND B%=0 THEN B%=L%
630 IF FURNACENOZ>NOZ(L%) AND F%=0 THEN F%=L%
640 NEXT L%
650 IF F%=0 THEN F%=L%-1
660 IF B%=0 THEN B%=L%
670 IF B%>1 THEN B%=B%-1 :
    'B%=CHART POS. OF BURNERNOZ
    F%=                FURNACENOZ DOWN 1
680 IF B%>=F% THEN 760 :'ALREADY BELOW FURNACENOZ-1
                         NO DOWNSIZING REC.
690 T=375
700 FOR DSS=1 TO 9 : T=T+50 :
    IF STACKTEMP<T THEN 710 ELSE
    NEXT DSS
710 BDSS=B%+DSS :
    IF BDSS>F% THEN BDSS=F% :'FURNACENOZ-1
    BDSS=CHART POS. OF NEW NOZZLE
720 NOZZLE(3)=NOZ(BDSS) :
    IF TANKLESS=1 AND NOZZLE(3)<.85
    THEN NOZZLE(3)=.85
730 IF NOZZLE(3)<NOZZLE(2)
    THEN NOZZLE(3)=NOZZLE(2)
740 IF NOZZLE(3)>=BURNERNOZ
    THEN 760 :'NO RECOMMENDATION
750 COUNT=COUNT+1 :
    RECODE(COUNT)=4 :'NOZZLE
```

```
760 IF TYPE<>1 THEN 780 :
    'REDUCE FAN SETTING
770 COUNT=COUNT+1 :
    RECODE(COUNT)=7 :
    GOTO 800
780 IF TYPE<>4 THEN 800 :
    'INSTALL CIRC. PUMP
790 COUNT=COUNT+1 :
    RECODE(COUNT)=8
800 IF SOLENOID=1 THEN 820 :
    'INSTALL SOLENOID
810 COUNT=COUNT+1 :
    RECODE(COUNT)=2 :'SOLENOID
820 GOTO 1290 :'RECOMMENDATION SECTION
900 '
910 'PROCEDURE  C C C C C  C C C C C  C C C C C  C C C
     ADD RET. HEAD
920 COUNT=COUNT+1 :
    RECODE(COUNT)=3 :'RETENTION HEAD
930 IF OILPERDD=0 THEN 950
940 NOZZLE(3)=NOZZLE(2) :
    GOTO 760
950 NOZZLE(3)=(HTNGLOAD*(AVGTMP+14)*3.414*1.15*(100/80))/140000!
960 FOR L%=1 TO 10 :
    IF NOZZLE(3)>NOZ(L%) THEN 970
    ELSE NEXT L%
970 IF L%>1 THEN L%=L%-1
980 NOZZLE(3)=NOZ(L%)
990 IF TANKLESS=1 AND NOZZLE(3)<.85
    THEN NOZZLE(3)=.85
1000 GOTO 760
1010 IF EFFICIENCY<68 THEN 900 :'PROCEDURE C
1020 COUNT=COUNT+1 :
    RECODE(COUNT)=6 :'TUNE
1030 GOTO 500 :'PROCEDURE A
1040 IF SMOKE<2 OR SMOKE>3 THEN 1220
1050 IF EFFICIENCY<75 THEN 1100
1060 IF SERVICED=1 THEN 1080
1070 COUNT=COUNT+1 :
     RECODE(COUNT)=1 :'SERVICE
1080 GOTO 500
```

```
1100 'PROCEDURE  B B B BB B B B B BB B B B B BB B B B B BB B
1110 COUNT=COUNT+1 :
     RECODE(COUNT)=5 :'NEW FURNACE
1120 IF OILPERDD=0 THEN 1140
1130 NOZZLE(3)=NOZZLE(2) :
     GOTO 1190
1140 NOZZLE(3)=(HTNGLOAD*(AVGTMP+14)*3.414*1.15*(100/80))/140000!
1150 FOR L%=1 TO 10 :
     IF NOZZLE(3)>NOZ(L%) THEN 1160
     ELSE NEXT L%
1160 IF L%>1 THEN L%=L%-1
1170 NOZZLE(3)=NOZ(L%)
1180 IF TANKLESS=1 AND NOZZLE(3)<.85
     THEN NOZZLE(3)=.85
1190 IF TYPE<>1 THEN 800
1200 COUNT=COUNT+1 :
     RECODE(COUNT)=7 :'LOWER FAN SETTINGS
1210 GOTO 800
1220 IF EFFICIENCY<68 THEN 1100
1230 IF SERVICED=1 THEN 1020
1240 COUNT=COUNT+1 :
     RECODE(COUNT)=1 :'SERVICE
1250 GOTO 1020
1260 IF SERVICED =1 THEN 1280
1270 COUNT=COUNT+1 :
     RECODE(COUNT)=1 :'SERVICE
1280 IF SMOKE=2 OR SMOKE=3 THEN 500
     ELSE 1020
1290 LABEL$(42)="SERVICING" :
     LABEL$(43)="SOLENOID VALVE" :
     LABEL$(44)="RETENTION HEAD"
1300 LABEL$(45)="NOZZLE SIZE" :
     LABEL$(46)="SYSTEM" :
     LABEL$(47)="TUNING"
1310 LABEL$(48)="FAN SETTINGS" :
     LABEL$(49)="CIRCULATING PUMP"
1320 'RECOMMENDATIONS
1330 EFFICIENCY(1)=EFFICIENCY :
     EFFICIENCY(2)=EFFICIENCY
```

```
1340 IF COUNT=0 THEN 1650
1350 FOR L%=1 TO COUNT :
     ON RECODE(L%) GOTO 1360,1390,1420,1470,1520,
                         1570,1590,1610
1360 'SERVICE
1370 PROCOST(42)=50 : SAVING=.05 :
     M%=42 : GOSUB 1630
1380 GOTO 1640
1390 'SOLENOID
1400 PROCOST(43)=75 : SAVING=.03 :
     M%=43 : GOSUB 1630
1410 GOTO 1640
1420 'RETENTION HEAD
1430 PROCOST(44)=600
1440 SAVING=(80-EFFICIENCY)/EFFICIENCY  :
     IF SAVING>.15
     THEN SAVING=.15
1450 M%=44 : GOSUB 1630 : EFFICIENCY(2)=EFFICIENCY+SAVING :
     IF EFFICIENCY(2)>80 THEN EFFICIENCY(2)=80
1460 GOTO 1640
1470 'REDUCE NOZZLE SIZE
1480 PROCOST(45)=10
1490 SAVING=.03
1500 M%=45 : GOSUB 1630
1510 GOTO 1640
1520 'NEW FURNACE
1522 IF ANSWER$(610)="1" THEN 1524 ELSE 1530
1524 PROCOST(46)=900 :GOTO 1540
1530 PROCOST(46)=1630
1540 SAVING=(80-EFFICIENCY)/EFFICIENCY :
         EFFICIENCY(2)=80
1550 M%=46 : GOSUB 1630
1560 GOTO 1640
1570 'TUNE
1580 PROCOST(47)=30 : SAVING=.05 :
     M%=47 : GOSUB 1630 : GOTO 1640
1590 'REDUCE FAN SETTING
1600 PROCOST(48)=.00005 : SAVING=.04 :
     M%=48 : GOSUB 1630 : GOTO 1640
1610 'CIRC. PUMP
1620 PROCOST(49)=300 : SAVING=.25 :
     M%=49 : GOSUB 1630 : GOTO 1640
1630 XX=OILHTCOST :
         IF TANKLESS=1 THEN XX=XX+.5*DHWCOST
1635 SAVINGS(M%)=SAVING*XX :
     PROPBACK(M%)=PROCOST(M%)/SAVINGS(M%) :
     RETURN
1640 NEXT L%
1650 'END OF HEATING SYSTEM ROUTINE
```

```
2000 'TOTAL SAVINGS FROM FURNACE RETROFIT,
      INSULATION AND SEALING MEASURES
2010 FOR L%=1 TO 40 :
     IF PROPBACK(L%)>20 THEN 2030
2020 SAVENV=SAVENV+SAVINGS(L%)
2030 NEXT L%
2040 FOR L%=41 TO 60 :
     IF PROPBACK(L%)>20 THEN 2060
2050 SAVOIL=SAVOIL+SAVINGS(L%)
2060 NEXT L%
2070 SAVTOT=((SAVENV*(SPCHTCOST-SAVOIL))/SPCHTCOST)
         +((SAVOIL*(SPCHTCOST-SAVENV))/SPCHTCOST)
2080 NOZZLE(6)=NOZZLE(5)*((SPCHTCOST-SAVTOT)/SPCHTCOST)
2090 FOR L%=1 TO 10 :
     IF NOZZLE(6)>NOZ(L%) THEN 2100 ELSE
     NEXT L%
2100 IF L%>1 THEN L%=L%-1
2110 NOZZLE(7)=NOZ(L%)
2120 IF TANKLESS=1 AND NOZZLE(7)<.85
     THEN NOZZLE(7)=.85
2130 OILHTCOST(1)=OILHTCOST :
     OILHTCOST(2)=OILHTCOST-SAVTOT
2135 IF ANSWER$(70)="3" THEN 3000
2140 IF ANSWER$(70)<>"1" THEN 5000
3000 'WOOD ROUTINE
3010 IF ANSWER$(105)="0" THEN 5000 :'SKIP ROUTINE
3015 IF ANSWER$(101)="4"
     AND ANSWER$(102)<>"4"
     THEN WOODUSED=VAL(ANSWER$(103))/10
     ELSE WOODUSED=0
3020 OILEQUIVALENT=WOODUSED*454 :
     COSTCORD=VAL(ANSWER$(106)) :
     HEATED=100-VAL(ANSWER$(35))
3030 IF ANSWER$(107)="1" THEN 3070 :
     'NEED A CHIMNEY
3040 COSTMETER=100
3050 IF N23%<15 THEN HT=6 ELSE
     IF N23%=15 THEN HT=8.5 ELSE
     IF N23%=20 THEN HT=9.7 ELSE
     HT=12
3060 CHIMCOST=HT*COSTMETER
3070 '
3080 FLAG=1
3090 PEAKHEATKW(FLAG)=(HTNGLOAD*(AVGTMP+14))/1000 :
     PEAKHEATBTU(FLAG)=PEAKHEATKW(FLAG)*3414.4
3100 PH2=NOZZLE(5)*(EFFICIENCY(FLAG)/100)*140000!
3105 IF PH2>PEAKHEATBTU(FLAG)
     OR PH2=0 THEN 3200
3110 PEAKHEATBTU(FLAG)=PH2 :
     PEAKHEATKW(FLAG)=PEAKHEATBTU(FLAG)*2.9287E-04
```

```
3200 DIM WCOST(2,4,2)
3210 'ARRAY OF COSTS -
      ACROSS 1)FURNACE   2)BOILER
      DOWN 4 PEAKHEATBTU >300000 TO <100000
      BACK 1)INSTALLATION COST 2)UNIT COST
3220 FOR AC=1 TO 2 :
     FOR DN=1 TO 4 :
     FOR BK=1 TO 2
3230 READ WCOST(AC,DN,BK)
3240 NEXT BK :
     NEXT DN :
     NEXT AC
3250 DATA 400,1500,400,1500,400,2500,400,2800
3260 DATA 400,900,400,1800,400,1800,400,1800
3270 IF (TYPE=2 OR TYPE>=4) THEN AC=2
     ELSE AC=1
3280 DN=CINT(PEAKHEATBTU(FLAG)/100000!+.5)
3285 IF DN>4 THEN DN=4
3290 INST(FLAG,1)=WCOST(AC,DN,1) :
     UNIT(FLAG,1)=WCOST(AC,DN,2) :
     BOX(FLAG)=PEAKHEATBTU(FLAG)/353*HEATED/100
3295 BOX(FLAG)=BOX(FLAG)*((30000/PEAKHEATBTU(FLAG))^.5)
3300 IF BOX(FLAG)<135 THEN 3320
3310 UNIT(FLAG,2)=1100 : INST(FLAG,2)=60 : GOTO 3350
3320 IF BOX(FLAG)<90 THEN 3340
3330 UNIT(FLAG,2)=900 : INST(FLAG.2)=50 : GOTO 3350
3340 INST(FLAG.2)=40 : IF BOX(FLAG)<30 THEN UNIT(FLAG.2)=700
                        ELSE UNIT(FLAG.2)=600
3350 WOODNEED(FLAG)=(OILHTCOST(FLAG)/COSTOIL83)/454
3355 WOODNEED(FLAG)=WOODNEED(FLAG)+WOODUSED
3360 TCOST(FLAG.1)=INST(FLAG,1)+UNIT(FLAG.1)+CHIMCOST
3370 TCOST(FLAG.2)=INST(FLAG,2)+UNIT(FLAG,2)+CHIMCOST
3380 FOR L%=1 TO 4
3390 SUPPLIED(FLAG.L%)=L%*25 :
     CORDS(FLAG,L%)=WOODNEED(FLAG)*(SUPPLIED(FLAG,L%)/100)
3399 'ROUND UP HALF A CORD
3400 LL%=INT(CORDS(FLAG,L%)) : LL=CORDS(FLAG,L%)-LL% :
     IF LL>=.5 THEN
     CORDS(FLAG,L%)=LL%+1 ELSE
     CORDS(FLAG,L%)=LL%+.5
3410 WSAVING(FLAG,L%)=((454*COSTOIL83)-COSTCORD)*CORDS(FLAG,L%) :
     WPYBKCH(FLAG,L%)=TCOST(FLAG,1)/WSAVING(FLAG,L%) :
     WPYBKSV(FLAG,L%)=TCOST(FLAG,2)/WSAVING(FLAG,L%)
3420 NEXT L%
3430 IF FLAG=2 THEN 4000
3440 FLAG=2 :
     PEAKHEATBTU(FLAG)=PEAKHEATBTU(1)*(1-SAVENV/SPCHTCOST) :
     PEAKHEATKW(FLAG)=PEAKHEATBTU(FLAG)*2.9287E-04 :
     GOTO 3270
4000 COSTDHWCOIL=350 :
     WDHWSAVING=(.45*DHWCOST)-COSTCORD :
     WDHWPBACK=COSTDHWCOIL/WDHWSAVING
4010 IF WDHWSAVING <= 0! THEN WDHWSAVING = 0!
4020 IF WDHWSAVING <= 0! THEN WDHWPBACK = 20
5000 CHAIN MERGE "AUDITOUT.SJ4",,ALL,DELETE 10-5000
```

```
10 'AUDITOUT   AUDITOUT   AUDITOUT   AUDITOUT
20 COMMON FILENAME$
30 PRINT CHR$(&H1A) : FOR L%=1 TO 5 : PRINT : NEXT L%
40 PRINT TAB(17);"HOME ENERGY SURVEY" : PRINT
60 PRINT TAB(20);"FINDINGS AND"
80 PRINT TAB(19);"RECOMMENDATIONS" : PRINT
100 PRINT TAB(17);"FOR: ";ANSWER$(6)
120 PRINT TAB(22);ANSWER$(1)
140 FOR L%=1 TO 2000 : NEXT L% :'DUMMY LOOP TO LEAVE
                                MESSAGE ON SCREEN LONG
                                ENOUGH TO READ
150 GOSUB 3000
160 GOSUB 1730
200 'ASSIGN PRIORITIES 1 TO 26 (MAXIMUM)
     BASED ON PROPBACK
210 DIM PRIORITY(80)
220 PRINT CHR$(&H1A);"PRIORIZING AND SORTING RESULTS"
230 P=0 : MIN=98 : TRIP=MIN
240 FOR L%=1 TO 80 : IF PROPBACK(L%)=0
    OR PROPBACK(L%)>20 THEN PROPBACK(L%)=99
250 NEXT L%
260 FOR L%=1 TO 80 :
    IF PROPBACK(L%)<MIN THEN MIN=PROPBACK(L%)
270 NEXT L%
280 IF TRIP=MIN THEN 350 :'DONE
290 P=P+1 :'PRIORITY NUMBER
300 FOR L%=1 TO 80 :
    IF PROPBACK(L%)=MIN THEN PRIORITY(L%)=P
310 IF PROPBACK(L%)=MIN THEN PROPBACK(L%)=
    PROPBACK(L%)+21
320 NEXT L%
321 PRINT"SORTING"
330 MIN=21 : TRIP=MIN
340 GOTO 260
350 'DONE PRIORIZING
400 FOR L%=1 TO 80 :
    IF PROPBACK(L%)<>99 THEN PROPBACK(L%)=
    PROPBACK(L%)-21
410 NEXT L%
420 'SCREEN-0 DISPLAY-0
430 TOPIC$="INSULATION"
440 FOR L%=1 TO P : FOR M%=1 TO 20 :
    IF PRIORITY(M%)=L% THEN GOSUB 560
450 NEXT M% :
    NEXT L%
460 TOPIC$="SEALING"
470 FOR L%=1 TO P : FOR M%=21 TO 40 :
    IF PRIORITY(M%)=L% THEN GOSUB 560
480 NEXT M% :
    NEXT L%
490 TOPIC$="HEATING SYSTEM"
500 FOR L%=1 TO P : FOR M%=41 TO 60 :
    IF PRIORITY(M%)=L% THEN GOSUB 560
510 NEXT M% :
    NEXT L%
520 TOPIC$="HOT WATER SYSTEM"
```

```
530 FOR L%=1 TO P : FOR M%=61 TO 80 :
    IF PRIORITY(M%)=L% THEN GOSUB 560
540 NEXT M% :
    NEXT L%
550 GOTO 2000
560 PRINT CHR$(&H1A);TOPIC$;" RECOMMENDATION" : PRINT
580 T$="WHAT WAS ANALYZED: "
590 PRINT T$;LABEL$(M%)
600 PRINT "PRIORITY: ";PRIORITY(M%):
620 IF PROPBACK(M%)<=5 THEN
     PRINT "*" ELSE PRINT
640 T$="RECOMMENDATION: "
650 PRINT T$;
660 IF M%>=11 THEN 740
661 'INSULATION RECOMMENDATION
665 IF M%=10 THEN 710
667 IF M%=9  THEN 710
668 IF M%=8  THEN 715
670 'INSULATION RECOMMENDATION
671 IF M%>7     THEN 710
680 T$="ADD INSULATION TO UPGRADE"
690 PRINT T$
700 PRINT TAB(17);"FROM EXISTING ":RSI(M%):
        " RSI TO ";OPTRSI(M%);" RSI."
701 IF M%=4 THEN GOTO 702 ELSE GOTO 720
702 T$=" BY ADDING BLOWN-IN INSULATION TO UNINSULATED WALL AREA":PRINT T$
703 T$=" CAULKING CEILING AND FLOOR TRIM WITH QUALITY CAULK":PRINT T$
704 T$=" AND ADDING KITCHEN FAN VENTED TO OUTSIDE AND":PRINT T$
705 T$=" CONTROLLED BY HUMIDISTAT":PRINT T$:GOTO 720
710 T$="ADD 89 MM BATT TO UNINSULATED WALL AREA"
713 PRINT T$:GOTO 1600
715 T$="ADD 150 MM RIGID INSULATION ROOF SYSTEM"
716 PRINT T$
720 'ADD REQUIREMENT CODE HERE
730 GOTO 1600 :'COST, P'BACK, SAVINGS
740 IF M%>20 THEN 890
800 'STORM WINDOWS AND DOORS
810 T$="INSTALL STORM "
820 PRINT T$;
830 IF M%=11 THEN PRINT "WINDOWS"; ELSE
     PRINT "DOORS";
850 T$=" WHERE LACKING."
860 PRINT T$
870 'ADD REQ. CODE HERE
880 GOTO 1600 :'C,P,S
890 IF M%>40 THEN 970
900 'SEALING
910 T$="USE QUALITY CAULK AND WEATHERSTRIPPING"
920 PRINT T$
930 PRINT TAB(17);"TO SEAL ALL AIR LEAKS."
950 'ADD REQ. CODE HERE
960 GOTO 1600
970 IF M%>60 THEN 1400
1000 'HEATING SYSTEM
1010 ON M%-40 GOTO 1020,1070,1100,1130,1170,1240,
                 1280,1290,1300
```

```
1020 T$="LOWER THERMOSTAT SETTINGS TO"
1030 PRINT T$
1040 T$="20 (68) DAY AND 17 (63) NIGHT."
1050 PRINT T$
1060 GOTO 1600
1070 T$="HAVE SYSTEM SERVICED."
1080 PRINT T$
1090 GOTO 1600
1100 T$="INSTALL SOLENOID VALVE."
1110 PRINT T$
1120 GOTO 1600
1130 T$="INSTALL RETENTION HEAD KIT."
1140 PRINT T$
1150 T$="WITH A MINIMUM NOZZLE SIZE##.##" :
     PRINT USING T$;NOZZLE(3)
1160 GOTO 1600
1170 T$="INSTALL NEW BURNER NOZZLE DOWNSIZED"
1180 PRINT T$
1190 IF BURNERNOZ=0 THEN 1210
1200 T$="FROM EXISTING##.## TO MINIMUM##.##" :
     PRINT USING T$;BURNERNOZ,NOZZLE(3)
1210 IF FURNACENOZ=0 THEN 1230
1220 T$="TO A MINIMUM OF##.##" :
     PRINT USING T$;NOZZLE(3)
1230 GOTO 1600
1240 T$="INSTALL NEW HIGH EFFICIENCY FURNACE."
1250 PRINT T$
1260 T$="WITH A MINIMUM NOZZLE SIZE##.##" :
     PRINT USING T$;NOZZLE(3)
1270 GOTO 1600
1280 T$="HAVE SYSTEM TUNED.":
     PRINT T$  :
     GOTO 1600
1290 T$="REDUCE FAN SETTINGS TO 120 F AND 90 F.":
     PRINT T$ :
     GOTO 1600
1300 T$="INSTALL CIRCULATING PUMP.":
     PRINT T$ :
     GOTO 1600
1400 ON M%-60 GOTO 1410,1440,1470,1481
1410 T$="INCREASE TANK INSULATION"
1420 PRINT T$
1430 GOTO 1600
1440 T$="REDUCE TEMPERATURE TO 49 (120)."
1450 PRINT T$
1460 GOTO 1600
1470 T$="INSTALL FLOW RESTRICTOR ON SHOWER.":GOTO 1600
1480 PRINT T$
1481 T$ = "CONVERT TO SELF-CONTAINED HOT WATER TANK IN SUMMER"
1482 PRINT T$
1490 GOTO 1600
```

```
1600 'COST, PAYBACK, SAVINGS
1610 IF DIYCOST(M%)=0 THEN 1670
1620 PRINT :
     T$="DO-IT-YOURSELF COST $$###" :
     PRINT USING T$;DIYCOST(M%)
1630 T$="                  PAYBACK LESS THAN" :
     PRINT T$;
1640 X=DIYPBACK(M%)+.5 :
     IF X=0 THEN X=1
1650 T$="### YEAR" :
     IF X>1 THEN T$=T$+"S"
1660 PRINT USING T$;X
1670 PRINT :
     T$="CONTRACTOR COST $$###" :
     PRINT USING T$;PROCOST(M%)
1680 T$="             PAYBACK LESS THAN" :
     PRINT T$;
1690 X=PROPBACK(M%)+.5 :
     IF X=0 THEN X=1
1700 T$="### YEAR" :
     IF X>1 THEN T$=T$+"S"
1710 PRINT USING T$;X
1720 PRINT :
     T$="SAVINGS $$###" :
     PRINT USING T$;SAVINGS(M%)
1730 INPUT "PRESS RETURN TO PROCEED":A$
1750 RETURN
2000 IF ANSWER$(105)="0" THEN 3200
2010 FOR L%=2 TO 0 STEP -1
2020 IF L%=0 THEN 2210
2030 PRINT CHR$(&H1A):
     T$="WOOD HEAT ADVICE ENERGY CONSERVATION":
     IF L%=2 THEN T$=T$+" CARRIED OUT" ELSE
                  T$=T$+" NOT CARRIED OUT"
2040 PRINT T$
2050 IF (TYPE=1 OR TYPE=3) THEN U$="FURNACE"
        ELSE U$="BOILER "
2060 T$=U$+" SIZE ### KW ( ###### BTU/HR )" :
     PRINT USING T$;PEAKHEATKW(L%),PEAKHEATBTU(L%)
2070 PRINT
2080 T$="STOVE         ### LITRES ( ##.# CUBIC FEET )":
     PRINT USING T$;BOX(L%),BOX(L%)*.035315
2090 PRINT
2100 T$="COSTS "+U$+" $$#####    STOVE $$#####":
     PRINT USING T$;UNIT(L%,1),UNIT(L%,2)
2110 T$=" INSTALLATION $$#####           $$#####":
     PRINT USING T$;INST(L%,1),INST(L%,2)
2120 T$="      CHIMNEY $$#####           $$#####":
     PRINT USING T$;CHIMCOST,CHIMCOST
2130 PRINT TAB(14);"________";TAB(33);"_____"
2140 T$="        TOTAL $$#####           $$#####":
     T1=UNIT(L%,1)+INST(L%,1)+CHIMCOST:
     T2=UNIT(L%,2)+INST(L%,2)+CHIMCOST
2150 PRINT USING T$;T1,T2
2160 PRINT :
     INPUT "PRESS RETURN TO PROCEED";T$
```

```
2200 'SECOND DISPLAY
2210 PRINT CHR$(&H1A)
2220 IF L%=0 THEN PRINT "PRECEEDING TABLES COMBINED"
2230 T$="SAVINGS & PAYBACK DEPEND ON WOOD USED":
     PRINT T$
2240 T$="CORDS  % HEAT  SAVINGS PAYBACK PAYBACK":
     PRINT T$
2250 T$="      SUPPLIED          STOVE  "+U$:
     PRINT T$
2260 T$="###    ###    $$###  ##.#    ##.#"
2270 IF L%=0 THEN 2400
2280 FOR LL%=1 TO 4
2290 PRINT
2300 IF WPYBKSV(L%,LL%)>5 THEN
        PRINT CHR$(&H1B);CHR$(&H29);:'DIM DISPLAY
2310 PRINT USING T$;CORDS(L%,LL%),SUPPLIED(L%,LL%),WSAVING(L%,LL%),
        WPYBKSV(L%,LL%),WPYBKCH(L%,LL%)
2320 NEXT LL%
2330 PRINT CHR$(&H1B);CHR$(&H28):
     INPUT "PRESS RETURN TO PROCEED";T$
2340 NEXT L%
2400 'COMBINED DISPLAY - HEADING ALREADY DONE
2410 FOR L%=1 TO 4
2420 FOR LL%=2 TO 1 STEP -1 :
     PRINT CHR$(&H1B);CHR$(&H28);:
     IF LL%=1 THEN PRINT CHR$(&H1B);CHR$(&H29):
2430 PRINT USING T$;CORDS(LL%,L%),SUPPLIED(LL%,L%),WSAVING(LL%,L%),
        WPYBKSV(LL%,L%),WPYBKCH(LL%,L%)
2440 NEXT LL%:
     NEXT L%
2450 PRINT CHR$(&H1B);CHR$(&H28);
2460 T$=U$+" RATING KW(BTU/HR)   ###(######)":
     PRINT USING T$;PEAKHEATKW(2),PEAKHEATBTU(2);
2470 PRINT CHR$(&H1B);CHR$(&H29);:
     T$="  ###(######)":
     PRINT USING T$;PEAKHEATKW(1),PEAKHEATBTU(1)
2480 PRINT CHR$(&H1B);CHR$(&H28);
2490 T$="STOVE FIREBOX SIZE LITRES(CU.FT.) ###(#.#)":
2500 PRINT CHR$(&H1B);CHR$(&H29);:T$=" ###(#.#)":PRINT USING T$;
       BOX(1),BOX(1)*.035315
2520 PRINT CHR$(&H1B);CHR$(&H28)
2530 GOSUB 1730
2600 'DISPLAY DHW WOOD ASSISTED SAVINGS
2610 T$="WOOD ASSISTED DHW HEATING" :
     PRINT CHR$(&H1A);T$ :PRINT
2620 T$="PROJECTED DHW HEATING COST $$###" :
     PRINT USING T$;DHWCOST
2630 T$="INSTALLED COST COIL AND PREHEAT TANK $$###" :
     PRINT USING T$;COSTDHWCOIL
2640 T$="SAVINGS $$###" :
     PRINT USING T$:WDHWSAVING
2650 T$="PAYBACK LESS THAN" :
     PRINT T$
2660 X=WDHWPBACK+.5
2670 T$="### YEAR" :
     IF X>1 THEN T$=T$+"S"
2680 PRINT USING T$;X
2800 GOSUB 1730 :
     GOTO 3200
```

```
3000 'DISPLAY OF CALC. VALUES
3010 PRINT CHR$(&H1A) :
     T$="PROJECTED SPACE HEATING COST $$####" :
     PRINT USING T$;SPCHTCOST
3020 T$="PROJECTED DHW HEATING COST $$###" :
     PRINT USING T$;DHWCOST
3030 T$="CURRENT FURNACE EFFICIENCY ##.#%" :
     PRINT USING T$;EFFICIENCY
3040 T$="CURRENT BURNER NOZZLE SIZE" :
     PRINT T$
3050 IF BURNERNOZ>0 THEN 3070
3060 T$=" UNKNOWN" :
     PRINT T$ :
     GOTO 3079
3070 T$="##.##" :
     PRINT USING T$;BURNERNOZ
3079 IF NOZZLE(2)=0 THEN 3089
3080 T$="MINIMUM NOZZLE BEFORE RETROFIT##.##" :
     PRINT USING T$;NOZZLE(2)
3089 IF NOZZLE(7)=0 THEN 3100
3090 T$="MINIMUM NOZZLE AFTER  RETROFIT##.##" :
     PRINT USING T$;NOZZLE(7)
3100 T$="AIR CHANGE LOSSES#####" :
     PRINT USING T$;ACLOSS
3110 T$="CONDUCTIVE LOSSES#####" :
     PRINT USING T$;CONDLOSS
3120 T$="FREEHEAT#####" :
     PRINT USING T$:FREEHEAT%
3130 T$="CALCULATED HEATING COST BASED ON ABOVE$$####" :
     PRINT USING T$;CLCHC
3140 T$="ENVELOPE AND HEATING SYSTEM RETROFIT SAVINGS$$####" :
        PRINT USING T$;SAVTOT
3150 RETURN
3200 REM
3210 IF AAS$="0" THEN 5000
3211 'AAS$ WAS RESPONSE IN CRUNCH
      IF QUESTION WAS ASKED - 0 = DO NOT SAVE DATA
3220 KILL FILENAME$
3230 OPEN "O",#1,FILENAME$
3240 FOR L%=1 TO 800 :
        PRINT #1,ANSWER$(L%) :
     NEXT L% :'WRITE ANSWERS TO FILE
3250 'NOW WRITE RESULTS TO FILE
3310 PRINT #1,FREEHEAT%,DHWUSED%,SNGLWNDO%
3320 PRINT #1,SNGLDOOR%,MOISTURE%,DUMMY%
3325 PRINT #1,DUMMY%,DUMMY%,DUMMY%
3330 PRINT #1,RCF,HEATFCTR,SLCFCTR
3340 PRINT #1,CLCHC,TOT.ENV.AREA,CONDLOSS
3350 PRINT #1,ACLOSS,DHWCOST,SPCHTCOST
3360 PRINT #1,REPLACOST,SBYCOST,HTNGLOAD
3370 PRINT #1,SAVENV,SAVOIL,SAVTOT
3380 PRINT #1,ACE,AVGTMP,TSTATERR
3390 PRINT #1,ENVINDEX,COSTOIL,COSTOIL83
3400 PRINT #1,CHIMCOST,WDHWSAVING,DUMMY
```

```
10 COMMON FILENAME$
20 'CRUNCH - AUDIT ANALYZER
30 OPTION BASE 1
40 IF FILENAME$<>"" THEN 70
50 LINE INPUT "METER NUMBER: ";FILENAME$
60 FILENAME$="B:X"+LEFT$(FILENAME$,5)+"."+
        RIGHT$(FILENAME$,3)
70 OPEN "I",#1,FILENAME$
80 DIM ANSWER$(800),CHEK$(800)
90 DIM SUBAREA(13),DCOST(13),PCOST(13),
        OPTRSI(80),RSI(80),LABEL$(80)
100 DIM SAVINGS(80),DIYCOST(80),PROCOST(80),
        DIYPBACK(80),PROFBACK(80)
110 FOR L%=1 TO 800 :
        LINE INPUT#1,ANSWER$(L%) :
        NEXT L%
120 CLOSE : J%=0 : PRINT CHR$(&H1A);
    "BEFORE I PROCEED WITH DATA ANALYSIS"
130 PRINT "DO YOU WANT TO:" :
    PRINT "(1) PROCEED" :
    PRINT "(2) DISPLAY AN ANSWER" :
    PRINT "(3) CHANGE AN ANSWER"
140 INPUT A$ : IF (A$<>"1" AND A$<>"2"
        AND A$<>"3") THEN 130 ELSE
        IF A$="1" THEN 210
150 INPUT "QUESTION #: ";L% :
    IF L%<1 OR L%>800 THEN 150
160 IF A$="3" THEN 190
170 PRINT CHR$(&H1A);"ANSWER ";L%;" IS ";
        ANSWER$(L%)
180 FOR L%=1 TO 4000 : NEXT L% :
    PRINT CHR$(&H1A) : GOTO 130
190 J%=1 : PRINT CHR$(&H1A);
        "OLD ANSWER ";L%;" WAS ";ANSWER$(L%) :
  PRINT "NEW ANSWER ";L%;"  IS "; :
  LINE INPUT ANSWER$(L%)
200 PRINT CHR$(&H1A) : GOTO 130
```

```
210 IF J%=0 THEN 240 ELSE
    PRINT CHR$(&H1A);"DO YOU WANT NEW DATA VALUES"
220 PRINT "STORED ON DISC"
230 INPUT "(0) NO; (1) YES";AAS$
240 DIM OPENING(4,3)
250 DIM A(4,5) : FOR A%=1 TO 4 : FOR D%=1 TO 5 :
        READ A(A%,D%) : NEXT D% : NEXT A%
260 DATA 232,58,33,11,7,215,53,21,10.6
270 DATA 305,76,44,15,7,541,135,77,27,17
280 FOR L%=1 TO 5 : READ WC%(L%) : NEXT L%
290 DATA 50,60,75,90,110
300 '
310 'ENVELOPE AREA
        BY SUBAREAS FIRST
320 LC%=0
330 FOR L%=310 TO 510 STEP 20
340 LC%=LC%+1
350 FOR M%=L% TO L%+8 STEP 2
360 SUBAREA(LC%)=(VAL(ANSWER$(M%))/10)
        *(VAL(ANSWER$(M%+1))/10)
        +SUBAREA(LC%)
370 NEXT M%
380 PRINT CHR$(&H1A):"THINKING 375";L%
390 TOT.ENV.AREA=TOT.ENV.AREA
        +SUBAREA(LC%)
400 NEXT L%
410 '
420 'DECREMENT SUB AREAS BY WINDOWS AND DOORS
        S-M-L WINDOW AREAS .5-1-1.5
        ALL DOORS - 2
430 FOR L%=201 TO 268 :
        IF ANSWER$(L%)="" THEN 540
440 IF L%>200 AND L%<221 THEN AREA = .5
        ELSE IF L%>220 AND L%<241 THEN AREA=1
        ELSE IF L%>240 AND L%<261 THEN AREA =1.5
        ELSE IF L%>260 AND L%<269 THEN AREA=2
```

```
450 'SINGLE WINDOW AND DOOR COUNT AND AREA
       FOR SAVINGS/COST/PAYBACK LATER
460 IF MID$(ANSWER$(L%),2,1)>"1" THEN 490
470 IF AREA<2 THEN SNGLWNDO%=SNGLWNDO%+1
       ELSE SNGLDOOR%=SNGLDOOR%+1
480 IF AREA<2 THEN
       SUBAREA(12)=SUBAREA(12)+AREA ELSE
       SUBAREA(13)=SUBAREA(13)+AREA
490 LC%=VAL(MID$(ANSWER$(L%),1,1)) :
       SUBAREA(LC%)=SUBAREA(LC%)-AREA
500 '
510 'TOTAL WINDOW AND DOOR AREA
       BY TYPE ACROSS
       BY GLAZING DOWN
520 TYPE%=AREA*2 : GLAZING%=VAL(MID$(ANSWER$(L%),2,1))
530 OPENING(TYPE%,GLAZING%)=OPENING(TYPE%,GLAZING%)
       +AREA
540 NEXT L%
550 PRINT "THINKING 650"
560 '
570 'CONDUCTIVE LOSS CALCULATION
       WINDOWS AND DOORS FIRST
580 'ASSUMED RSI'S WINDOWS .15 - .35 - .50
       DOORS .5 - .7 - .7
590 CONDLOSS=0
600 FOR TYPE%=1 TO 4 :
       FOR GLAZING%=1 TO 3
610 IF TYPE%=4 THEN 640
620 IF GLAZING%=1 THEN RSI =.15
       ELSE IF GLAZING%=2 THEN RSI=.35
       ELSE RSI = .5
630 GOTO 650
640 IF GLAZING%=1 THEN RSI=.5
       ELSE RSI=.7
650 CONDLOSS=CONDLOSS+OPENING(TYPE%,GLAZING%)/RSI
```

```
660 NEXT GLAZING% :
         NEXT TYPE%
670 '
680 BSMTTMP%=VAL(ANSWER$(36)) :
    HTABVGRD(9)=VAL(ANSWER$(520))/10 :
    HTABVGRD(10)=VAL(ANSWER$(522))/10
690 PRINT "THINKING 815"
700 'NOW SUBAREAS
         DERIVE RSI OF EACH
710 'ASSUMED RSI/MM  1-BATTS(1.55/89)
                     2-LOOSE(1.55/89)
                     3-BOARD(.031)
720 L%=300
730 'BASEMENT FLOOR OR SLAB RSI VALUE
740 IF ANSWER$(26)="3" THEN RSI(11)=4
                       ELSE RSI(11)=7
750 IF BSMTTMP%<=15 AND ANSWER$(26)="1"
                       THEN RSI(11)=100
760 FOR LC%=1 TO 11 : L%=L%+20 :
         IF SUBAREA(LC%)=0 THEN 1050
770 IF LC%<9 THEN RSI(LC%)=.7 :'BASE VALUE UNINSULATED AREA
780 IF LC%=3 OR LC%=5 OR LC%=6
         THEN RSI(LC%)=.2
790 IF LC%=11 THEN 870
800 FOR M%=L% TO L%+4 STEP 2
810 IF ANSWER$(M%)="" THEN 850 :'NEXT M%
820 TYPE%=VAL(ANSWER$(M%)) :
         THICK%=VAL(ANSWER$(M%+1))
830 IF TYPE%=1 THEN RSI=1.55/89
         ELSE IF TYPE%=2 THEN RSI=1.55/89
         ELSE RSI=.031
840 RSI(LC%)=RSI(LC%)+RSI*THICK%
850 NEXT M%
860 IF LC%=9 OR LC%=10 THEN 890
870 IF RSI(LC%)>0 THEN
         CONDLOSS=CONDLOSS+SUBAREA(LC%)/RSI(LC%)
880 GOTO 1050
890 'CONDUCTIVE LOSSES THROUGH BASEMENT WALL
900 IF RSI(LC%)>0 THEN 920
910 KO(LC%)=1 : GOTO 950 :'KO()=1=UNINSULATED WALL
920 IF (LC%=9 AND VAL(ANSWER$(521))=
         VAL(ANSWER$(471))) OR (LC%=10   AND VAL(ANSWER$(523))=VAL(ANSWER$(491)
         THEN 940
930 KO(LC%)=2 : GOTO 950 :'KO()=2=PARTIALLY INS. WALL
940 KO(LC%)=3 :'KO()=3=FULLY INSULATED WALL
950 S=SUBAREA(LC%)*1.42*(BSMTTMP%/18)
960 ON KO(LC%) GOTO 970,990,1010
970 CLOSS(LC%-2)=S*1.1*(.4+((.6*HTABVGRD(LC%)*1000)/460))
980 GOTO 1020
990 CLOSS(LC%-2)=S*1.05*(.81+.19*HTABVGRD(LC%)*1000/460)*
         (.319+.681/(1+RSI(LC%)/.391))
1000 GOTO 1020
```

```
1010 CLOSS(LC%-2)=S*(.73+.27*HTABVGRD(LC%)*1000/460)*
       (.095+.905/(1+RSI(LC%)/.37))
1020 CONDLOSS=CONDLOSS+CLOSS(LC%-2)
1030 IF KD(LC%)=3 THEN 1050
1040 CLOSS(LC%)=S*1*(.73+.27*HTABVGRD(LC%)*1000/460)*
       (.095+.905/(1+1.55/.37))
1050 NEXT LC%
1060 '
1070 'AIR CHANGE RATE
1080 'MOISTURE RATING
1090 OCCUPANTS%=VAL(ANSWER$(27)) :
       IF OCCUPANTS%>4 THEN M%=3
       ELSE IF OCCUPANTS%>2 THEN M%=2
       ELSE M%=1
1100 OCCUPANTLVL%=M%
1110 BSMTHUM%=VAL(ANSWER$(51))+1
1120 M%=M%+BSMTHUM% :
       IF BSMTTMP%>15 AND BSMTHUM%=2 THEN M%=M%+1
1130 CDRYING%=VAL(ANSWER$(52))+1 :
       M%=M%+CDRYING%
1140 HMDFRUSE%=VAL(ANSWER$(53))+1 :
       M%=M%+HMDFRUSE%
1150 IF M%>8 THEN MOISTURE%=3
       ELSE IF M%>5 THEN MOISTURE%=2
       ELSE MOISTURE%=1
1160 HUMLVL%=VAL(ANSWER$(54))+1
1170 IF HUMLVL%=3 THEN ACE=.2+MOISTURE%/10
       ELSE IF HUMLVL%=2 THEN ACE=.4+MOISTURE%/10
       ELSE ACE=.6+MOISTURE%/10
1180 IF ANSWER$(37)="1" THEN ACE=ACE*1.5 :'EXPOSURE EXTREME
1190 '
1200 PRINT "THINKING 1135"
1210 'AVERAGE BUILDING TEMP
1220 AVGTMP=(VAL(ANSWER$(31))+VAL(ANSWER$(32))+
       VAL(ANSWER$(33))) / 3
1230 'CORRECTED FOR CUT-IN ERROR
1240 INDOOR=VAL(ANSWER$(280)) : CUTIN=VAL(ANSWER$(281)) :
    IF INDOOR>CUTIN THEN TSTATERR=INDOOR-CUTIN
    ELSE TSTATERR=(-1)*(CUTIN-INDOOR)
1250 AVGTMP=AVGTMP+TSTATERR
1260 '
1270 'ENVELOPE INDEX
       FUNCTION OF Q.23 AND Q.25
1280 N23%=VAL(ANSWER$(23)) : N25%=VAL(ANSWER$(25))
1290 ENVINDEX=1.06 :
       IF N23%=20 THEN ENVINDEX=1.02 :'2 STOREY
1300 IF (N23%=20 AND N25%=2)
       OR N23%=5 THEN ENVINDEX=1.16 :
       'L-SHAPED 2-STOREY OR SPLIT LEVEL
1310 IF (N23%=10 AND N25%=2)
       THEN ENVINDEX=1.2 :'L-SHAPED 1-STOREY
1320 '
1330 'AIR CHANGE LOSS
1340 ACLOSS=(ACE*1300*((TOT.ENV.AREA/(ENVINDEX*6))^1.5))/3600
1350 PRINT "THE PREDICTED AIR CHANGE/ HOUR =",ACE
```

```
1360 '
1370 'HEATING LOAD
1380 HTNGLOAD=ACLOSS+CONDLOSS
1390 '
1400 PRINT "THINKING 1425"
1410 'HEATING COST ANALYSIS
1420 COSTOIL83=.363 :'<---<< $ COST OF 1L OIL IN '82/'83
1430 EFFICIENCY=VAL(ANSWER$(644))/10
1440 '
1450 ' UPGRADED FREE HEAT CALCULATION
1460 ' INCLUDES CONTRIBUTIONS FROM
1470 ' APPLIANCES, LIGHTS, PEOPLE,
1480 ' DOMESTIC H. WATER AND SOLAR GAIN
1490 ' IN THE FOUR CARDINAL DIRECTIONS
1500 ' N,E,S, AND W
1510 ' READ THE SUMMER ELECTRIC BILLS FROM DATA SHEET
1520 ' BOXES 108 THRU 117
1530 ' PROGRAM DEFAULTS TO BUILT-IN VALUES
1540 ' IF BILLS FROM MAY TO SEPT ARE NOT
1550 ' INCLUDED
1560 '
1570 FOR J%=108 TO 113:
        IF ANSWER$(108)="0" THEN 1780
1580 IF J%=109 THEN 1610
1590 IF J%=110 THEN DYTOT1= VAL(ANSWER$(110)):GOTO 1610
1600 IF J%=111 THEN MONTH = VAL(MID$(ANSWER$(111),3,2))
1610 NEXT J%
1620 IF MONTH <5 AND MONTH >10
     THEN 1630 ELSE IF MONTH >5 AND MONTH <10 THEN 1640
1630 DYTOT1=0:KWTOT1=0:GOTO 1650
1640 KNTOT1= VAL(ANSWER$(112))
1650 FOR J%=114 TO 116:
        IF ANSWER$(J%)= "" THEN 1780
1660 IF J%=114 THEN DYTOT2= VAL(ANSWER$(114)):GOTO 1680
1670 IF J%=115 THEN MONTH = VAL(MID$(ANSWER$(115),3,2))
1680 NEXT J%
1690 IF MONTH <5 OR MONTH >10
     THEN 1700 ELSE IF MONTH >5 OR MONTH <10 THEN 1710
1700 DYTOT2=0: KWTOT2=0:GOTO 1720
1710 KWTOT2 = VAL(ANSWER$(116))
1720 KWTOT = KWTOT1 + KWTOT2
1730 DYTOT = DYTOT1 + DYTOT2
1740 IF KWTOT=0 OR DYTOT=0 THEN 1810
1750 KWANN = KWTOT/DYTOT * 365 *(8/12):GOTO 1880
1760 '
1770 ' DEFAULT ELECTRIC VALUES FOR HEATING SEASON(8 MONTHS)
```

```
1780 ' DEFAULT VALUES ARE APPLIANCE,LIGHTING AND STANDBY DHW TANK
1790 ' TANK LOSSES TOTALLED TOGETHER AS A FUNCTION OF
1800 ' NUMBER OF PEOPLE FROM ANSWER$(27)
1810 '
1820 IF ANSWER$(27) <"4" THEN KWANN = 4680*.67:GOTO 1860
1830 IF ANSWER$(27) ="4" THEN KWANN = 7080*.67:GOTO 1860
1840 IF ANSWER$(27) ="5" THEN KWANN = 9480*.67:GOTO 1860
1850 IF ANSWER$(27) >"5" THEN KWANN =11880*.67
1860 FREEHEAT%= KWANN*3413/1E+06:GOTO 2090
1870 '
1880 ' FREE HEAT FROM HOT WATER CONSUMPTION
1890 ' AS A FUNCTION OF HOT WATER USED
1900 DHWUSED%=20 : IF ANSWER$(41)="1"
     THEN DHWUSED%=DHWUSED%+15
1910 IF ANSWER$(42)="1" THEN DHWUSED%=DHWUSED%+10
1920 B%=VAL(ANSWER$(43)) : S%=VAL(ANSWER$(44)) :
         B%=B%/OCCUPANTS% : S%=S%/OCCUPANTS% :
         DHWUSED%=DHWUSED%+B%*9+S%*6
1930 DHWCONS= DHWUSED%*OCCUPANTS%*.07*365*.67
1940 IF ANSWER$(600)="0" THEN 2010
1950 IF ANSWER$(600)="1" THEN 2000
1960 IF ANSWER$(600)="2" THEN 2020
1970 IF ANSWER$(600)="3" THEN 2000
1980 IF ANSWER$(600)="4" THEN 2000
1990 IF ANSWER$(600)="5" THEN 2000
2000 FREEHEAT%= (KWANN*3413)/1E+06:GOTO 2040
2010 FREEHEAT%= (KWANN*3413)/1E+06:GOTO 2070
2020 FREEHEAT%= ((KWANN-DHWCONS)*3413)/1E+06
2030 IF FREEHEAT% <= 0 THEN 2050
2040 FREEHEAT% = FREEHEAT% + (DHWCONS*.08*3413)/1E+06:GOTO 2070
2050 FREEHEAT%=(DHWCONS*.08*3413)/1E+06
2060 ' WHERE .07 KWH/LITRE-DAY:.08( 8% OF ENERGY(HOTCAN)
2070 ' 365*.67 ACCOUNTS FOR HEATING SEASON ONLY
2080 '
2090 ' FREEHEAT FROM PEOPLE IS 1.6 KWH/PERSON/DAY
2100 FREEHEAT% = FREEHEAT% +
     (VAL(ANSWER$(27))*1.6*365*.67*3413)/1E+06
2110 '
2120 ' SOLAR GAIN CALCULATION
2130 '
2140 SC(1)=.93: SC(2)=.85: SC(3)=.75
2150 FOR J%= 201 TO 256:
          IF ANSWER$(J%)="" THEN 2310
2160 IF J%>200 AND J%<221  THEN AREA=.5
         ELSE IF J%>220 AND J%<241 THEN AREA=1!
         ELSE IF J%>240 AND J%<256 THEN AREA=1.5
2170 GLAZING% = VAL(MID$(ANSWER$(J%),2,1))
2180 FOR O%= 1 TO 4:
          ON O% GOTO 2190,2220,2250,2280
2190 IF MID$(ANSWER$(J%),4,1) <>"3" THEN 2300
2200 SOLAR = SOLAR + AREA*(930965!)*SC(GLAZING%)
```

```
2210 GOTO 2300
2220 IF MID$(ANSWER$(J%),4,1) <>"2" THEN 2300
2230 SOLAR = SOLAR + AREA*(1.2902E+06)*SC(GLAZING%)
2240 GOTO 2300
2250 IF MID$(ANSWER$(J%),4,1) <>"4" THEN 2300
2260 SOLAR = SOLAR + AREA*(973478!)*SC(GLAZING%)
2270 GOTO 2300
2280 IF MID$(ANSWER$(J%),4,1) <>"1" THEN 2300
2290 SOLAR = SOLAR + AREA*(571712!)*SC(GLAZING%)
2300 NEXT O%
2310 NEXT J%
2320 FREEHEAT% = FREEHEAT% + SOLAR/1E+06
2330 SOLARK = SOLAR/3413
2340 PRINT "SOLAR";SOLARK
2350 ' THE FREEHEAT IN MMBTU/YEAR IS NOW CONVERTED
2360 ' TO W/C FOR FUEL CALCULATION
2370 ' 1 MMBTU/YR = 2.438 W/C FOR THE HEATING SEASON
2380 ' OR 1 MMBTU/YR = 1E+06/( DD * CONVERSION FACTOR)
2390 ' DD = 4804 (ST. JOHN'S) AND FACTOR = 85.37
2400 FREEHEAT% = FREEHEAT%*2.44
2410 PRINT "FREE(W/C)",FREEHEAT%
2420 '
2430 'CALCULATED HEATING COST
2440 IF EFFICIENCY=0 THEN EFFICIENCY=75
2450 CLCLITERS=(HTNGLOAD-FREEHEAT%)*86400!
     *(4804+(AVGTMP-14)*169)
     /3.7E+07*100
     /(EFFICIENCY-10)
2460 CLCHC=CLCLITERS*COSTOIL83
2470 FUEL=VAL(ANSWER$(70)) : FF(1)=1 : FF(2)=1.53/1.46 :
     FF(3)=1.36/1.46 : FF(4)=.5 : FF(5)=1 : FF(6)=1
2480 CLCHC=CLCHC*FF(FUEL)
2490 IF ANSWER$(71)>"0" THEN 2510
2500 OILHTCOST=CLCHC :
     GOTO 3050
2510 ON VAL(ANSWER$(71)) GOTO 2520,2590,2720
2520 'HOMEOWNER'S ESTIMATE
2530 COSTOIL=.3 :'1981/'82 COST
2540 OILHTCOST=VAL(ANSWER$(75))
2550 IF ANSWER$(70)="3" THEN 2580
2560 OILHTCOST=COSTOIL83/COSTOIL*OILHTCOST
2570 GOTO 3050
2580 OILHTCOST=1.12*OILHTCOST:GOTO 3050:' 1.12
     IS ELECTRIC INFLATION FACTOR
     FOR 1982-83
2590 'YEARLY CONSUMPTION FROM RECORDS
2600 DATE$(1)=ANSWER$(73)
2610 FOR Q%=76 TO 94 STEP 3 :
     DATE$=ANSWER$(Q%) :
     IF DATE$="" THEN 2640
2620 DATE$(2)=DATE$ :
     OILUSED=OILUSED+VAL(ANSWER$(Q%+1)) :
     DOLLARS=DOLLARS+VAL(ANSWER$(Q%+2))
2630 NEXT Q%
```

```
2640 GOSUB 5090 : DAYS=ELAPSED.DAYS%
2650 DATE$(1)=ANSWER$(Q%-6) : GOSUB 5090
2660 UPERD=VAL(ANSWER$(Q%-2))/ELAPSED.DAYS% :
     DPERD=VAL(ANSWER$(Q%-1))/ELAPSED.DAYS%
2670 OILUSED=OILUSED+((365-DAYS)*UPERD) :
     DOLLARS=DOLLARS+((365-DAYS)*DPERD)
2680 IF ANSWER$(70)="3" THEN 2690 ELSE 2710
2690 COSTOIL=DOLLARS/OILUSED:
     OILHTCOST=.0524/COSTOIL*OILHTCOST:
     GOTO 3050:'OIL IS ACTUALLY KWH FOR
     CALCULATION
2700 ' 0.0524 IS DOLLARS/KWH FOR 1982-83
2710 COSTOIL=DOLLARS/OILUSED :
     OILHTCOST=COSTOIL83/COSTOIL*DOLLARS :
     GOTO 3050
2720 'LITERS/DD METHOD
2730 OPEN "R",#2,"SJNDAYC.DAT",8
2740 FIELD #2,8 AS DEGDAY$
2750 '
2760 'START OIL RECORDS - FIRST IS REF FOR DEG DAYS
2770 DATE$(1)="760101"
2780 DATE$(2)=ANSWER$(73) : GOSUB 5090
2790 REC%=DAY.YEAR%(2) : IF NUM.YEAR%(2)=80
         THEN REC%=REC%-258 ELSE
         IF NUM.YEAR%(2)=82 THEN REC%=REC%+321
2800 IF NUM.YEAR%(2)=81 AND DAY.YEAR%(2)<106
         THEN REC%=REC%+108
2810 IF NUM.YEAR%(2)=81 AND DAY.YEAR%(2)>257
         THEN REC%=REC%-44
2820 GET #2,REC%
2830 DEGDAY1=CVD(DEGDAY$)
2840 '
2850 PRINT "THINKING 1955"
2860 'SECOND(TO ALL) RECORD
2870 FOR L%=76 TO 94 STEP 3 :
     IF ANSWER$(L%)=""THEN 2900
2880 OILUSED=OILUSED+VAL(ANSWER$(L%+1)) :
     DOLLARS=DOLLARS+VAL(ANSWER$(L%+2))
2890 NEXT L%
2900 L%=L%-3 : DATE$(2)=ANSWER$(L%) : GOSUB 5090
2910 REC%=DAY.YEAR%(2) : IF NUM.YEAR%(2)=80
         THEN REC%=REC%-258 ELSE
         IF NUM.YEAR%(2)=82 THEN REC%=REC%+321
2920 IF NUM.YEAR%(2)=81 AND DAY.YEAR%(2)<106
         THEN REC%=REC%+108
2930 IF NUM.YEAR%(2)=81 AND DAY.YEAR%(2)>257
         THEN REC%=REC%-44
2940 GET #2,REC%
2950 DEGDAY2=CVD(DEGDAY$)
2960 DDINPERIOD=DEGDAY2-DEGDAY1
2970 OILPERDD=OILUSED/DDINPERIOD
2980 COSTOIL=DOLLARS/OILUSED
2990 OILHTCOST=4804/DDINPERIOD*DOLLARS
3000 IF ANSWER$(70)="3" THEN 3010 ELSE 3030
```

```
3010 OILHTCOST=.0524/COSTOIL*OILHTCOST:
     GOTO 3050 :'OIL IS ACTUALLY KWH FOR
     CALCULATION
3020 ' 0.0524 IS DOLLARS/KWH FOR 1982-83
3030 OILHTCOST=COSTOIL83/COSTOIL*OILHTCOST
3040 '
3050 'DHW COST CALCULATION
3060 IF ANSWER$(600)<"1" OR ANSWER$(600)>"4"
        THEN 3280 :'RUN AWAY! RUN AWAY! NOT OIL,
                          PROPANE, OR ELECTRIC
3070 'COMPUTE DHW HEATING $
3080 'DAILY USE PER PERSON
3090 IF ANSWER$(600)="2" THEN RCF = 1.36
        ELSE IF ANSWER$(600)="3" THEN RCF=1.53
        ELSE RCF=1.46
3100 '
3110 PRINT "ALMOST DONE"
3120 'HEATING FACTOR - HEATFCTR
3130 DHWTMP=VAL(ANSWER$(300))
3140 IF DHWTMP>67 THEN HEATFCTR=1 ELSE
        IF DHWTMP>62 THEN HEATFCTR=.9 ELSE
        IF DHWTMP>57 THEN HEATFCTR=.8 ELSE
        IF DHWTMP>52 THEN HEATFCTR=.7 ELSE HEATFCTR=.6
3150 '
3160 REPLACOST=DHWUSED%*OCCUPANTS%*RCF*HEATFCTR
3170 IF ANSWER$(600)="1" THEN 3230
3180 INSUL%=VAL(ANSWER$(603)) : CAPACITY%=VAL(ANSWER$(601))
3190 IF INSUL%>87 THEN D%=5 ELSE
        IF INSUL%>62 THEN D%=4 ELSE
        IF INSUL%>37 THEN D%=3 ELSE
        IF INSUL%>12 THEN D%=2 ELSE D%=1
3200 IF (ANSWER$(600)="2" AND CAPACITY%>50) THEN A%=4
  ELSE IF (ANSWER$(600)="2" AND CAPACITY%>30) THEN A%=3
  ELSE IF (ANSWER$(600)="2" AND CAPACITY%>0) THEN A%=2
        ELSE A%=1
3210 SLCFCTR=A(A%,D%)
3220 SBYCOST=SLCFCTR*HEATFCTR
3230 DHWCOST=REPLACOST+SBYCOST
3240 IF ANSWER$(71)="0" THEN 3280
3250 IF ANSWER$(600)<>"1" AND ANSWER$(600)<>"4"
        THEN 3280
3260 IF DHWCOST>OILHTCOST THEN DHWCOST=OILHTCOST
3270 IF ANSWER$(71)<"3" THEN OILHTCOST=OILHTCOST-DHWCOST
        ELSE OILHTCOST=OILHTCOST-(DHWCOST*.5)
3280 IF ANSWER$(101)="3" THEN INFLATE=1.12 ELSE
        IF ANSWER$(101)="4" THEN INFLATE=1.12 ELSE
        IF ANSWER$(101)="6" THEN INFLATE=1.12 ELSE
        INFLATE=1.21
3290 SPCHTCOST=OILHTCOST+INFLATE*VAL(ANSWER$(104))
3300 '
3310 'SAVING-COST-PAY BACK
3320 'IF EXISTING RSI IS 70% OF OPTIMUM SKIP
3330 CON=SPCHTCOST*HTNGLOAD/(HTNGLOAD-FREEHEAT%)
3340 M%=0 : RSI(12)=.15 : RSI(13)=.5
```

```
3350 FOR L%=1 TO 13 :
     IF L%=11 THEN 3740 :'SKIP BASEMENT FLOOR
3360 M%=M%+1 :
     READ LABEL$(M%),OPTRSI(M%),DCOST(M%),PCOST(M%)
3370 DATA MAIN WALL,2.1,0,10.76
3380 DATA ADDED WALL,2.1,0,10.76
3390 DATA KNEE WALL,2.1,4.2,8.60
3400 DATA EXPOSED FLOOR,4.6,0,43.6
3410 DATA MAIN ATTIC.6.0,1.2,1.9
3420 DATA ADDED ATTIC.6.0,1.2,1.9
3430 DATA SLOPED ATTIC.2.1,0,28
3440 DATA FLAT ROOF.4.1,0,28
3450 DATA FOUNDATION,2.1,9.7,45.8
3460 DATA ADDED FOUNDATION,2.1,9.7,45.8
3470 DATA STORM WINDOWS,.35,100,130
3480 DATA THERMAL DOORS,1.4,200,267
3490 IF SUBAREA(L%)<=0 THEN 3740
3500 IF L%<9 OR L%>10 THEN 3570
3510 IF KO(L%)=3 THEN 3740
3520 'SAVINGS FOR FOUNDATION
3530 SAVINGS(M%)=(CLOSS(M%-2)-CLOSS(M%))*CON/HTNGLOAD
3540 IF KO(L%)=1 THEN 3590
3550 KO=SUBAREA(L%) : SUBAREA(L%)=SUBAREA(L%)*
       (VAL(ANSWER$(521+((L%-9)*2)))/
        VAL(ANSWER$(471+((L%-9)*20)))) :
 THE ABOVE CALCS AREA OF UNINSULATED WALL
3560 GOTO 3590
3570 IF RSI(L%)>(.7*OPTRSI(M%)) THEN 3740:'NEXT L%
3580 SAVINGS(M%)=CON*SUBAREA(L%)/
       RSI(L%)/HTNGLOAD*(1
       -RSI(L%)/OPTRSI(M%))
3590 ON L% GOTO 3610,3610,3610,3690,3690,3690,3610,
       3610,3610,3610,3610,3610,3610
3600 'WALLS AND SLOPED ATTIC
3610 DIYCOST(M%)=SUBAREA(L%)*DCOST(M%)
3620 PROCOST(M%)=SUBAREA(L%)*PCOST(M%)
3630 IF DCOST(M%)>0 THEN DIYPBACK(M%)
       =DIYCOST(M%)/SAVINGS(M%)
3640 PROPBACK(M%)=PROCOST(M%)/SAVINGS(M%)
3650 IF L%<9 OR L%>10 THEN 3740
3660 'SET SUBAREA OF PARTIALLY INSULATED WALL
       BACK TO TOTAL.
3670 IF KO(L%)=2 THEN SUBAREA(L%)=KO
3680 GOTO 3740
3690 'AREA WHOSE COST ARE FUNC. OF RSI AS WELL AS AREA
3700 DCOST(M%)=DCOST(M%)*(OPTRSI(M%)-RSI(L%))
3710 IF L%=4 THEN 3610
3720 PCOST(M%)=PCOST(M%)*(OPTRSI(M%)-RSI(L%))
3730 GOTO 3610
3740 NEXT L%
3750 '
```

```
3760 'DHW SUMMARY WORKSHEET
3770 PRINT "JUST A FEW SECONDS MORE"
3780 LABEL$(61)="TANK INSULATION" :
     LABEL$(62)="TEMPERATURE SETTING" :
     LABEL$(63)="FLOW RESTRICTORS":
     LABEL$(64)="TANKLESS COIL IN SUMMER"
3790 IF ANSWER$(600)>"0" AND ANSWER$(600)<"5"
        THEN 3820 :'OIL, GAS, OR ELECTRIC
3800 'I AM SORRY BUT YOUR HOT WATER
     HEATING SYSTEM IS NOT OIL, PROPANE
     OR ELECTRIC.  I AM UNABLE TO GIVE
     ADVICE ON YOUR SYSTEM.
3810 GOTO 4100
3820 'COMPUTED DAILY USE (L): DHWUSED%
     MEASURED TEMPERATURE (C): DHWTMP
     COMPUTED ANNUAL COST ($): DHWCOST
3830 IF ANSWER$(600)="1" THEN 4000 : 'CONVERT TO ELECTRIC
        HOT WATER IF TANKLESS COIL
3840 'ACTION: REDUCE TEMP. TO 50 DEGREES C!
3850 IF DHWTMP<=52 THEN 3870
3860 SBCKFCTR=HEATFCTR-.6 :
        SAVINGS(62)=SBCKFCTR*DHWCOST :
        PROPBACK(62)=.00005 :'NO COST BUT NEEDS TO BE <>0
3870 'ACTION: ADD TANK INSULATION!
3880 TNKINSUL=VAL(ANSWER$(603)) :
        IF TNKINSUL>50 THEN 4040 :'AMPLE INSULATION
3890 IF ANSWER$(604)="0" THEN 4040 :'NO CLEARANCE
3900 IF TNKINSUL=0 THEN PROCOST(61)=90
        ELSE PROCOST(61)=60
3910 IF TNKINSUL=0 THEN DIYCOST(61)=30
        ELSE DIYCOST(61)=20
3920 IF ANSWER$(600)="2" THEN 3950 :'ELECTRIC
3930 IF TNKINSUL=0 THEN SAVINGS(61)=152
        ELSE SAVINGS(61)=24
3940 GOTO 3990
3950 IF TNKINSUL=0 GOTO 3980 :'UNINSULATED ELECTRIC
3960 IF CAPACITY%>50 THEN SAVINGS(61)=54  ELSE
     IF CAPACITY%>30 THEN SAVINGS(61)=31  ELSE
     SAVINGS(61)=22
3970 GOTO 3990
3980 IF CAPACITY%>50 THEN SAVINGS(61)=353 ELSE
     IF CAPACITY%>30 THEN SAVINGS(61)=200  ELSE
     SAVINGS(61)=141
3990 PROPBACK(61)=PROCOST(61)/SAVINGS(61) :
     DIYPBACK(61)=DIYCOST(61)/SAVINGS(61):GOTO 4040
4000 RRF =.003*DHWUSED%*90: SSF =25 - 9
4010 SAVINGS(64)=RRF + SSF
4020 PROCOST(64)= 240
4030 PROPBACK(64) = PROCOST(64)/SAVINGS(64)
4040 'ACTION: INSTALL FLOW RESTRICTOR ON SHOWER!
4050 IF ANSWER$(302)="0" THEN 4100 :'NOT SUITABLE
4060 IF S%=0 THEN 4100 :'SHOWER NOT USED
4070 PROCOST(63)=60 : DIYCOST(63)=30
```

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4080 SAVINGS(63)=(S%*6)/DHWUSED%*DHWCOST/2
4090 PROPBACK(63)=PROCOST(63)/SAVINGS(63) :
     DIYPBACK(63)=DIYCOST(63)/SAVINGS(63)
4100 'END OF DHW SUMMARY
4110 'TOTAL ENVELOPE AREA (M^2): TOT.ENV.AREA
     CONDUCTIVE LOSSES: CONDLOSS
     AIR CHANGE LOSSES: ACLOSS
     HEATING LOAD: HTNGLOAD
4120 'FREEHEAT: FREEHEAT%
     CALCULATED HEATING COST: CLCHC
4130 'OIL HEATING COST ($): OILHTCOST
4140 'TOTAL HEATING COST ($): SPCHTCOST
4150 '
4160 LABEL$(41)=" THERMOSTAT SETBACK SAVINGS"
4170 '
4180 IF ANSWER$(70)="4" OR ANSWER$(70)="6"
        THEN 4340 :'SKIP IF WOOD OR OTHER
4190 DAYCS%=   VAL(ANSWER$(31)) +TSTATERR:
     EVENCS% = VAL(ANSWER$(32)) +TSTATERR:
     NIGHTCS%= VAL(ANSWER$(33)) +TSTATERR
4200 T2=3 :'ST.JOHN'S AVG.WINTER DAY TEMP                       <-------<<
4210 T3=0 :'ST.JOHN'S AVG.WINTER NIGHT TEMP                     <-------<<
4220 IF ANSWER$(282)="1" THEN 4260 ELSE 4280:
     'CHECKS STATUS OF DAYTIME OCCUPANCY
4230 'PSD IS PERCENTAGE SAVING IN DAY(8 AM TO 4 PM)
4240 'PSE IS PERCENTAGE SAVING IN EVENING (4 PM TO MIDNIGHT)
4250 'PSN IS PERCENTAGE SAVING IN NIGHT (MIDNIGHT TO 8 AM)
4260 IF DAYCS% > 20 THEN PSD=(1/(AVGTMP-T2))*( 8/24)*100 ELSE PSD=0:
     IF EVENCS% > 20 THEN PSE=(1/(AVGTMP-T2))*( 8/24)*100 ELSE PSE=0:
     IF NIGHTCS% > 17 THEN PSN=(1/(AVGTMP-T3))*( 8/24)*100 ELSE PSN=0
4270 TPS=PSD*(DAYCS%-20)+PSE*(EVENCS%-20)+PSN*(NIGHTCS%-17):GOTO 4310
4280 'UNOCCUPIED DAYTIME SAVINGS CALCULATION
4290 IF DAYCS% > 17 THEN PSD=(1/(AVGTMP-T2))*( 8/24)*100 ELSE PSD=0:
     IF EVENCS% > 20 THEN PSE=(1/(AVGTMP-T2))*( 8/24)*100 ELSE PSE=0:
     IF NIGHTCS% > 17 THEN PSN=(1/(AVGTMP-T3))*( 8/24)*100 ELSE PSN=0
4300 TPS=PSD*(DAYCS%-17)+PSE*(EVENCS%-20)+PSN*(NIGHTCS%-17)
4310 SAVINGS(41)=(TPS/100)*CON:
     IF SAVINGS(41)=0 THEN SAVINGS(41)=.000001
4320 ' THIS PREVENTS DIVISION BY ZERO
4330 PROCOST(41)=110 :
     PROPBACK(41)=PROCOST(41)/SAVINGS(41)
4340 '
4350 'SEALING -- WINDOWS CAULK/W'STRIP
4360 'WINDOWS - TOTAL AREA, TOTAL AREA NEEDING SEAL
4370 FOR L%=201 TO 260
4380 I$=MID$(ANSWER$(L%),3,1) : IF I$="" THEN 4410
4390 IF L%>240 THEN AREA=1.5 ELSE
     IF L%>220 THEN AREA=1! ELSE
                    AREA=.5
4400 TOTAL(1)=TOTAL(1)+AREA :
        IF I$="1" THEN TOTAL(2)=TOTAL(2)+AREA
```

```
4410 NEXT L%
4420 PERCENT=TOTAL(2)/TOTAL(1) :
        IF PERCENT<=.3 THEN 4470 :'> 70% GOOD
4430 DCOST=7.5 : PCOST=3*DCOST :
        SAVED=.15*PERCENT
4440 SAVINGS(21)=SAVED*CON*ACLOSS/HTNGLOAD
4450 DIYCOST(21)=DCOST*TOTAL(2) :
     PROCOST(21)=PCOST*TOTAL(2)
4460 DIYPBACK(21)=DIYCOST(21)/SAVINGS(21) :
     PROPBACK(21)=PROCOST(21)/SAVINGS(21)
4470 '
4480 'SEALING -- DOORS CAULK/W'STRIP
4490 'DOORS - TOTAL AREA, TOTAL AREA NEEDING SEAL
4500 'PRETTY MUCH THE SAME AS WINDOW ROUTINE
4510 TOTAL(1)=0 : TOTAL(2)=0
4520 FOR L%=261 TO 268
4530 I$=MID$(ANSWER$(L%).3,1) : IF I$="" THEN 4560
4540 AREA=2 : TOTAL(1)=TOTAL(1)+AREA :
     IF I$="1" THEN TOTAL(2)=TOTAL(2)+AREA
4550 NEXT L%
4560 PERCENT=TOTAL(2)/TOTAL(1) :
        IF PERCENT<=.3 THEN 4610 :'>70% GOOD
4570 DCOST=10 : PCOST=24 :
        SAVED=.05*PERCENT
4580 SAVINGS(22)=SAVED*CON*ACLOSS/HTNGLOAD
4590 DIYCOST(22)=DCOST*TOTAL(2) :
     PROCOST(22)=PCOST*TOTAL(2)
4600 DIYPBACK(22)=DIYCOST(22)/SAVINGS(22) :
     PROPBACK(22)=PROCOST(22)/SAVINGS(22)
4610 '
4620 'SEALING -- BASEMENT. WALLS. & ATTIC
4630 'INFILTRATION RESPONSES - 0=REQUIRES   0% SEAL
                                 1=         50%
                                 2=        100%
4640 TOTAL(1)=0 : TOTAL(2)=0 : N=0
4650 FOR Q%=320 TO 362 STEP 2:CHEK$(Q%)=ANSWER$(Q%):NEXT Q%:
     IF CHEK$(320)="0" THEN 4710 ELSE 4660
4660 IF CHEK$(322)="0" THEN 4710 ELSE 4670
4670 IF CHEK$(340) ="0" THEN 4710 ELSE 4680
4680 IF CHEK$(342)  ="0" THEN 4710 ELSE 4690
4690 IF CHEK$(360)  ="0" THEN 4710 ELSE 4700
4700 IF CHEK$(362)  ="0" THEN 4710 ELSE 4750
4710 AREA(1) = SUBAREA(9) + SUBAREA(10)
4720 IF L%=1 THEN I= VAL(ANSWER$(271)
4730 P=I*.5 : N=N+P:
     TOTAL(2) = TOTAL(2)+P*AREA(1)
4740 GOTO 4800
4750 AREA(1)=SUBAREA(9)+SUBAREA(10) :
     AREA(2)=SUBAREA(1)+SUBAREA(2)+SUBAREA(3) :
     AREA(3)=SUBAREA(5)+SUBAREA(6)+SUBAREA(7)+SUBAREA(4)+
             SUBAREA(8)
4760 FOR L%=1 TO 3
4770 I=VAL(ANSWER$(270+L%))
4780 P=I*.5 : N=N+P :
     TOTAL(1)=TOTAL(1)+AREA(L%) :
     TOTAL(2)=TOTAL(2)+P*AREA(L%)
```

```
4790 NEXT L%
4800 IF N=0 THEN 4850 :'NO NEED
4810 DCOST=.2 : PCOST=4*DCOST :
         SAVED=.1*N
4820 SAVINGS(23)=SAVED*CON*ACLOSS/HTNGLOAD
4830 DIYCOST(23)=DCOST*TOTAL(2) :
     PROCOST(23)=PCOST*TOTAL(2)
4840 DIYPBACK(23)=DIYCOST(23)/SAVINGS(23) :
     PROPBACK(23)=PROCOST(23)/SAVINGS(23)
4850 '
4860 FOR Q%=320 TO 362 STEP 2:CHEK$(Q%)=ANSWER$(Q%):NEXT Q%:
     IF CHEK$(320) ="0" THEN 4920 ELSE 4870
4870 IF CHEK$(322) ="0" THEN 4920 ELSE 4880
4880 IF CHEK$(340) ="0" THEN 4920 ELSE 4890
4890 IF CHEK$(342) ="0" THEN 4920 ELSE 4900
4900 IF CHEK$(360) ="0" THEN 4920 ELSE 4910
4910 IF CHEK$(362) ="0" THEN 4920 ELSE 5050
4920 TOTAL(1)=0 :N=0
4930 AREA(1) = SUBAREA(1)+SUBAREA(2)+SUBAREA(3):
     AREA(2) = SUBAREA(5)+SUBAREA(6)+SUBAREA(7)+
               SUBAREA(8)+SUBAREA(4)
4940 FOR L%=1 TO 2 :I=2
4950 P=I*.5 : N=N+P :
     TOTAL(1)=TOTAL(1) + P*AREA(L%):NEXT L%
4960 SAVED =.1*N
4970 WALLSAVINGS=SAVED*CON*ACLOSS/HTNGLOAD
4980 FOR L%= 1 TO 3
4990 WALLSAVINGS= .6*WALLSAVINGS
5000 IF RSI(L%)>(.7*OPTRSI(L%)) THEN 5040
5010 SAVINGS(L%) = SAVINGS(L%) + WALLSAVINGS
5020 PROCOST(L%) = SUBAREA(L%)*PCOST(L%)
5030 PROPBACK(L%)=PROCOST(L%)/SAVINGS(L%)
5040 NEXT L%
5050 LABEL$(21)="WINDOW WEATHERSTRIP" :
     LABEL$(22)="DOOR WEATHERSTRIP" :
     LABEL$(23)="ENVELOPE CAULKING"
5060 PRINT "ARE  YOU  READY  FOR  THIS  ?"
5070 CHAIN MERGE "CRUNCH2.SJ4",,ALL,DELETE 10-5350
5080 STOP
5090 ' ******************************
       *******  ELAPSED.SUB *********
       ******************************
5100 ' SUBROUTINE TO COMPUTE ELAPSED DAYS (INCLUSIVE)
       I/P DATE$(1)  FORMAT YYMMDD
           DATE$(2)
5110 ' O/P ELAPSED.DAYS% -- [INCLUSIVE]
       DAY.YEAR%(1&2)-DAY.MONTH%(1&2)-NUM.YEAR%(1&2)
       NUM.MONTH%(1&2)
5120 ' DATE$(N) SHOULD BE PRE-EDITED
       BY EDITDATE.SUB
5130 FOR L%=1 TO 2 :
       DAY.MONTH%(L%)=VAL(RIGHT$(DATE$(L%),2)) :
       NUM.YEAR%(L%)=VAL(LEFT$(DATE$(L%),2))
5140 NUM.MONTH%(L%)=VAL(MID$(DATE$(L%),3,2)) :
       K%=NUM.MONTH%(L%) :
        FACTOR%=0 : YEARS%=0
```

```
5150 K%=K%-1 : J%=K%*30 :
       IF K%=1 THEN J%=J%+1 ELSE
       IF K%=2 THEN J%=J%-1 ELSE
       IF K%>4 THEN J%=J%+1
5160 IF K%=7 THEN J%=J%+1 ELSE
       IF K%>7 THEN J%=J%+2
5170 IF K%>9 THEN J%=J%+1 :
       'LEAP YEAR
5180 IF NUM.YEAR%(L%) MOD 4 = 0
       AND K%>1
       THEN J%=J%+1
5190 DAY.YEAR%(L%)=J%+DAY.MONTH%(L%)
5200 NEXT L%
5210 IF NUM.YEAR%(1)>NUM.YEAR%(2) THEN 5240  :
       'DIFFERENT YEARS? -- INPUT ORDER?
5220 IF NUM.YEAR%(1)<>NUM.YEAR%(2) THEN 5300
5230 IF DAY.YEAR%(1)<=DAY.YEAR%(2) THEN 5290 :
       'SAME YEAR -- INPUT ORDER?
        REVERSED! -- SWITCH THEM.
5240 SWAP DATE$(1),DATE$(2)
5250 SWAP DAY.MONTH%(1),DAY.MONTH%(2)
5260 SWAP NUM.YEAR%(1),NUM.YEAR%(2)
5270 SWAP DAY.YEAR%(1),DAY.YEAR%(2)
5280 SWAP NUM.MONTH%(1),NUM.MONTH%(2)
5290 IF NUM.YEAR%(1)=NUM.YEAR%(2) THEN 5340
5300 YEARS%=NUM.YEAR%(2)-NUM.YEAR%(1) :
       'YEARS HAVE ELAPSED
5310 FACTOR%=YEARS%*365 :
       'LEAP YEARS?
5320 FOR L%=0 TO YEARS%-1 :
       IF (NUM.YEAR%(1)+L%) MOD 4 = 0
       THEN FACTOR%=FACTOR% + 1
5330 NEXT L%
5340 ELAPSED.DAYS%=((DAY.YEAR%(2)+FACTOR%)
       -DAY.YEAR%(1)) +1
5350 RETURN
```

APPENDIX VI

ADVISOR SELECTION CRITERIA, ASSESSMENT FORMS AND GENERAL INFORMATION

Appendix VI-A

Energy Advisor Newspaper Advertisement

RESIDENTIAL ENERGY ADVISORS

A local energy consulting company is looking for eight people, women and men, to train as energy advisors.

The company is developing a residential energy advisory service sponsored by the Federal Department of Energy, Mines and Resources and require the advisors to assist homeowners in developing an energy conservation plan based on a comprehensive audit of the energy loss factors of the home.

Beginning on October 11, eight trainees will undergo an intensive five week course at the College of Trades and Technology followed by a period of training in the field. Subsequently, four graduates of this course will be hired to participate in a four week field trial.

Energy advisors will be paid five dollars an hour while they train and eight dollars an hour if they are selected for the field trial.

If you are over the age of 18, possess a valid drivers licence, have the ability to communicate well and are interested in the field of energy conservation, you are requested to pick up an application form at the College of Trades and Technology, Extension Services Department, on September 8th and 9th, 1982. The return address for the application will be indicated on the form. No applications will be accepted after September 17th, 1982.

Appendix VI-B

Energy Advisor Application Form

APPLICATION FOR EMPLOYMENT

RESIDENTIAL ENERGY ADVISORS

1. PERSONAL

Full Name: ______________ Date of Birth: ______________

Address: (Inc. Postal Code) ______________ Place of Birth: ______________

Tel. No: ______________

2. EDUCATION (Please list formal education only).

Education	Institution	Town/City	Qualifications	Date of Graduation
Secondary				
Post Secondary (List Chronologically)				

3. WORK EXPERIENCE List in Chronological Order (most recent to earliest experience). Be brief in your description. Highlight with * any experience you consider relevant to the position of Residential Energy Advisor.

Duration	Company	Position	Responsibilities

4. GENERAL

1. Have you had previous experience with computers. YES NO

   If yes, explain ______________

2. Have you ever taken any courses in energy conservation. YES NO

   If yes, please list ______________

3. Give a short statement on why you feel that you would be a successful Residential Energy Advisor. (Use the reverse side of this form and do not type your reply.

5. Are you available to commence the Training Program on October 12, 1982.
YES NO

6. Are you prepared to commit yourself to a ten week program, if necessary (6 week training, 4 weeks of audits). YES NO

7. Do you have a car you can use for this work (4 weeks of energy audits).
YES NO

8. I believe that, to the best of my ability, the information contained in this application is correct.

Signature ______________ Date: ______________

Appendix VI-C

Pre-Test Form

PRE-TEST

1. The Minister of Energy for Canada is
   - a) Marc Lalonde
   - b) Norman Hill
   - c) Jean Chretien

2. The ability of insulation to resist heat transfer is called its "R-value" TRUE ______ FALSE ______

3. What does COSP stand for?

   ____

4. A house that is 8 metres wide x 11 metres long x 3 metres high could be:
   - a) a two storey row house
   - b) a three-storey office building
   - c) a typical bungalow

5. Leaving the damper open when the fire place is not in use:
   - a) helps remove unwanted moisture from the home
   - b) allows heat to escape up the chimney
   - c) increases the oil furnace efficiency

6. You are the owner of an average size older home having a forced air oil fired heating system with an electrically heated hot water storage tank. Your house has annual fuel bills in excess of $2,000. How would you attempt to reduce your energy bill by adopting low cost energy conservation practices in your home? List these practices in order of importance (i.e. most important to least important).

   1. ______________________________________
   2. ______________________________________
   3. ______________________________________
   4. ______________________________________
   5. ______________________________________
   6. ______________________________________
   7. ______________________________________
   8. ______________________________________
   9. ______________________________________
   10. ______________________________________
   11. ______________________________________
   12. ______________________________________
   13. ______________________________________
   14. ______________________________________
   15. ______________________________________

Appendix VI-D

Preliminary Interview Assessment Sheet

RESIDENTIAL ENERGY ADVISOR TRAINEE

FACT SHEET

TRAINING COURSE

CONTRACTOR: ShawMont Newfoundland Limited
P. O. Box 9600
Virginia Park Plaza
Newfoundland Drive
St. John's, Newfoundland
A1A 3C1

754-0250

CONTACT: Mr. A. A. Dawe

Mr. R. W. Lewis

LOCATION OF TRAINING: College of Trades and Technology
St. John's, Newfoundland

TRAINING COORDINATOR: Mr. K. Griffiths
Director, Extension Services
College of Trades and Technology

SELECTION: 8 individuals

TRAINING SESSION BEGINS: Tuesday, October 12, 1982

TRAINING SESSION ENDS: Friday, November 19, 1982

COURSE HOURS: 9:00 - 5:00 p.m. (Monday - Friday)

HOURS PER WEEK: 37 1/2 hours
$5.00 per hour

OBJECTIVE OF TRAINING COURSE: To be able to perform the functions of residential energy advisor:

(1) Assess and evaluate the energy loss factors in the home
(2) Recommend an energy conservation plan to homeowners.

FIELD TRIAL ADVISOR

SELECTION: Four graduates of training program

DURATION: November 22, 1982 - December, 1982

WAGE: $8.00 hour plus expenses

JOB DESCRIPTION: Energy advisors will visit 100 houses to assess potential for increased energy conservation and assist homeowners in developing a plan for reducing energy costs.

INFORMATION SHEET

1. NAME: ____

2. ADDRESS: ____

__________________________ POSTAL CODE: __________

3. PHONE (DAY) ______________ (EVENINGS) ______________

4. DRIVERS LICENSE NUMBER ____________________________

5. ARE YOU AVAILABLE TO COMMENCE THE TRAINING PROGRAM ON OCTOBER 12?

YES NO

6. ARE YOU PREPARED TO COMMIT YOURSELF TO A TEN WEEK PROGRAM, IF NECESSARY? (6 weeks training, 4 weeks of audits).

YES NO

7. DO YOU HAVE A CAR YOU CAN USE FOR THIS WORK (4 weeks of energy audits)

YES NO

DATE: ____________________ SIGNATURE: ____________________

SCREENING INTERVIEW

WORKSHEET

Target time for interview - 5 minutes (4 minutes + 1 minute for form)

Applicant's Name ______________________________

Question: In reference to your answer to question 6, please explain your reasons for listing the energy conservation measures in that particular order.

Circle the appropriate number immediately following the interview.

RATE 1 - 10 (1 is poor - 10 is excellent)

1. Communication Skills (Speaking, communicating, ability to explain)

   1 2 3 4 5 6 7 8 9 10

2. Personal Appearance (Dress, habits, physical disabilities)

   1 2 3 4 5 6 7 8 9 10

3. Personal Relations Skills (Ability to establish rapport, engender trust)

   1 2 3 4 5 6 7 8 9 10

4. Attitude toward energy conservation (Positive attitude toward energy use)

   1 2 3 4 5 6 7 8 9 10

I would recommend interview YES _____ NO _____

If no, why? ______________________________

____

____

Interviewer ______________
(initial)

Attach to application.

Appendix VI-E

Secondary Interview Forms

FORMAL INTERVIEW

WORKSHEET

Target time for interview - 20 minutes

APPLICANT'S NAME: ______________________________

RATE 1 - 10 (1 is poor - 10 is excellent)

1. Communication Skills (Speaking, communicating, ability to explain) __________

2. Personal Appearance (Dress, habits, physical disabilities) __________

3. Personal Relations Skills (Ability to establish rapport, engender trust) __________

4. Attitude toward energy conservation (Positive attitude toward energy use) __________

I would recommend offer of employment Yes _____ No _____

If no, why? ______________________________

____

____

Interviewer ______________
(initial)

FORMAL INTERVIEW

QUESTIONS

1. What prompted you to apply for the position of Residential Energy Advisor?

2. Describe briefly your work experience to date and indicate what aspects you consider to be most relevant to the position of Residential Energy Advisor.

3. How will Canadian families cope with rising energy costs in the 1980's?

4. What steps have you taken to conserve energy in your own home?

5. Do you have any questions of ShawMont in relation to the position?

FORMAL INTERVIEW

QUESTIONS

1. What prompted you to apply for the position of Residential Energy Advisor?

2. Describe briefly your work experience to date and indicate what aspects you consider to be most relevant to the position of Residential Energy Advisor.

3. How will Canadian families cope with rising energy costs in the 1980's?

4. What steps have you taken to conserve energy in your own home?

5. Do you have any questions of ShawMont in relation to the position?

Appendix VI-F

Training Program Participants Information Sheets

RESIDENTIAL ENERGY ADVISOR

INFORMATION SHEET

1. PERSONAL

Full Name:	Tracey Marie Cook	Date of Birth:	September 14, 1961
Address: (Inc. Postal Code)	8 Blatch Avenue St. John's, Nfld. A1C 4P5	Place of Birth:	Corner Brook, Nfld.
		Tel. No:	(709) 579-1479

2. EDUCATION

Education	Institution	Town/City	Qualifications	Date of Graduation
Secondary	Hartman Collegate	Corner Brook Nfld.	Grade XI	June, 1982
Post Secondary (List Chronologically)	College of Trades & Technology	St. John's	Diploma of Apprisal/ Assessment	June 1982
	Memorial University of Nfld.	Corner Brook Nfld.	1½ Yrs. Commerce	
	Mt. St. Vincent University	Halifax, N.S.	½ Yr. Commerce	

3. WORK EXPERIENCE

Duration	Company	Position	Responsibilities
3 months	Property Appraisals Ltd.	Student (field work, CTT)	- accompanied appraisers on field inspections and assisted in completion of forms.
3 Summers	Canadian Tire Corp. Corner Brook	Pricing Clerk	- responsible for pricing of merchandise
4 months	Audio/Visual Dept. CTT	Student Asst.	- cataloguing and checking in and out A/V materials and equipment

RESIDENTIAL ENERGY ADVISOR

INFORMATION SHEET

1. PERSONAL

Full Name:	Gerard Joseph O'Brien	Date of Birth:	June 14, 1958
Address: (Inc. Postal Code)	108 Morgan Drive Gander, Nfld. A1V 2H9	Place of Birth:	St. John's, Newfoundland
		Tel. No:	256-7776

2. EDUCATION

Education	Institution	Town/City	Qualifications	Date of Graduation
Secondary	College of Fisheries	St. John's Nfld.	Marine Diesel 4th Engineer	April 1978-1979

Post Secondary (List Chronologically)

College of Fisheries

- * 1. Metric Conversion
- * 2. Fire Fighting Cert.
- 3. Standard First Aid Cert.

3. WORK EXPERIENCE

Duration	Company	Position	Responsibilities
1 year 1980 - 1981	Remo Contractors Calgary	Carpenter/ Builder	Renovations in office buildings and houses
2 months 1979 - 1980	Harveys Offshore Services	Motorman/ Engineer	Carry out repairs to main engine and auxiliary equipment
9 months 1979 - 1980	Harveys Offshore Services	4th Engineer	In charge of engine room for 8 hours a da

RESIDENTIAL ENERGY ADVISOR

INFORMATION SHEET

1. PERSONAL

Full Name: Frederick J. Doyle

Address: (Inc. Postal Code)
21 Bishop Drive
Gander, Nfld.
A1V 1V2

Date of Birth: May 27, 1964

Place of Birth: Gander, Nfld.

Tel. No: (709) 256-8578

2. EDUCATION

Education	Institution	Town/City	Qualifications	Date of Graduation
Secondary	St. Paul's Central High	Gander Nfld.	Grade XI Honours	June 1981
Post Secondary (List Chronologically)	St. Francis Xauier University	Antigonish Nova Scotia	Computer Science	Only completed 1 semester

3. WORK EXPERIENCE

Duration	Company	Position	Responsibilities
June 82 - Aug. 82	"Various"	Independant Surveying Person	Travelling around central Nfld. doing door to door statistical surveys for various companies
July 82- Sept. 82	Cara Caterers	Kitchen help and meals	Kitchen duties and the laying out of flight meals.
July 81 - Sept. 81	Gander-Bonavista R.C. School Board	Manual Labour duties	
Sept. 82 - Sept. 81	St. Joseph Parish Church, Gander	Janitor	Usual Janitorial duties

RESIDENTIAL ENERGY ADVISOR

INFORMATION SHEET

1. PERSONAL

Full Name: Bryan R. Dunne

Date of Birth: January 11, 1957

Address: (Inc. Postal Code)
32 Hawker Crescent
St. John's, Nfld.
A1E 3W4

Place of Birth: St. John's, Nfld.

Tel. No: (709) 364-8532

2. EDUCATION

Education	Institution	Town/City	Qualifications	Date of Graduation
Secondary	Gonzaga High	St. John's	Grade XI Matriculation	1973
Post Secondary (List Chronologically)	Mun	St. John's	Completed 1 ½ yrs. Commerce Program	

3. WORK EXPERIENCE

Duration	Company	Position	Responsibilities
3 months	Nfld. Liquor Corp.	Sales Clerk	taking stock; handling cash, dealing with customers.
3 months	Spartan Business Machines and Electronics	Sales Rep.	promtoing full line of business machines, and services, etc.
3 years	K-Mart Canada Ltd.	Ar. Asst Mgr.	maseling and staff for over $8 million annual sales
17 Months	Fredis Records Ltd.	Mgr/Sales Clerk	serving customers, ordering, etc.
10 months	CHCM Radio	Anner/Operator	on air presentation, ads, news
2 years	Metro Constr. & Engineering	Carpenter/ Electrican helper	general labour duties, etc.

RESIDENTIAL ENERGY ADVISOR

INFORMATION SHEET

1. PERSONAL

Full Name: Richard Joseph Mackey

Address: (Inc. Postal Code)
94 Larkhall Street
St. John's, Nfld.
A1B 2C6

Date of Birth: March 9, 1959

Place of Birth: Grand Falls, Nfld.

Tel. No: (709) 726-3995
(709) 882-2850
(Collect)

2. EDUCATION

Education	Institution	Town/City	Qualifications	Date of Graduation
Secondary	St. Michael's Regional High	Grand Falls Nfld.	Grade XI Honours	June, 1976
Post Secondary (List Chronologically)	Memorial University	St. John's Nfld.	Year 1, Pass	
	District Vocational	Grand Falls Nfld.	Basic Drafting	June, 1978
	District Vocational	Grand Falls Nfld.	Architectural Drafting	Uncompleted
	College of Trades and Technology	St. John's Nfld.	Year 1, Medical Sciences	Uncompleted
	Eastman Whipstock Training Center	Houston, Texas	Oilwell Surveying	Oct. 1981

3. WORK EXPERIENCE

Duration	Company	Position	Responsibilities
July'81 April'82	Eastman Whipstock Ltd.	Surveyor 1	Taking and calculation of Oilwell surveys. Servicing equipment
June - Sept. 1980	Provincial Dept. of Forestry	Labouror	Estimating amount of usuable wood in cutovers
June-Sept. 1979	Federal Dept. of Fisheries	Guardian	Patrol of Biscay Bay area for illegal activities related to fisheries
June-Sept. 1978	Provincial Dept. of Tourism (Parks Division)	Park Attendant	Park Maintenance, Issuing of park permit and As-campsites.
June-Sept. 1977	Same as above	Part Attendant	

RESIDENTIAL ENERGY ADVISOR

INFORMATION SHEET

1. PERSONAL

Full Name: Marquerite Moores-O'Donnell

Date of Birth: September 1, 1952

Address: (Inc. Postal Code)
80 Oxen Pond Road
St. John's, Nfld.
A1B 3J5

Place of Birth: St. John's, Nfld.

Tel. No: (709) 895-6480 or 722-3923

Res. Byrnes Road, Paradise

2. EDUCATION

Education	Institution	Town/City	Qualifications	Date of Graduation
Secondary	Prince of Wales Col.	St. John's Nfld.	Grade XI	1970-71
Post Secondary (List Chronologically)				

3. WORK EXPERIENCE

Duration	Company	Position	Responsibilities
6 years	Browning Harvey LTD.	Receptionist	Switchboard, cash sales filing, relief in sales dept. and other general office duties.
3 ½ years	Dr. Charles A. Janeway Child Health Center	Switchboard Operator and Clerical Positions in Out-Patient and Lab. Office	Telephones Drs. Clinics

RESIDENTIAL ENERGY ADVISOR

INFORMATION SHEET

1. PERSONAL

Full Name: Deborah A. Squires

Address: (Inc. Postal Code)
201 Hamilton Avenue
St. John's, Nfld.
A1E 1J6

Date of Birth: April 5, 1954

Place of Birth: St. John's, Nfld.

Tel. No: (709) 579-5573

2. EDUCATION

Education	Institution	Town/City	Qualifications	Date of Graduation
Secondary	Holy Heart of Mary	St. John's Nfld.	Grade II Acd.	June, 1971
Post Secondary (List Chronologically)	College of Trades and Technology	St. John's Nfld.	Comm. Art	June, 1973

3. WORK EXPERIENCE

Duration	Company	Position	Responsibilities
3 months (temp.)	Nfld. Herald	Production Tech.	Paste up/design and typesetting
3 yrs.	Robinson-Blackmore Prtg.	varied-book keeping, job costing, editor	moved from Friday position to Assoc. Editor over term.
3 months (Temp.)	Dept. of Health	CR II	Processing Incomes Supplement forms
intermittant for 1 year	C.B.C.	vocalist	singing and general entertainment
1 year	Daily News	Production Tech.	Paste/up typesetting

Also worked as photographer, dark room assistant, retail sales clerk.....

RESIDENTIAL ENERGY ADVISOR

INFORMATION SHEET

1. PERSONAL

Full Name: David George Weatherby

Date of Birth: September 28, 1950

Address: (Inc. Postal Code)
Apt. 217 225 Blackmarch Rd
St. John's, Nfld.
A1E 4T1

Place of Birth: Truro, Nova Scotia

Tel. No: (709) 579-4916

2. EDUCATION

Education	Institution	Town/City	Qualifications	Date of Graduation
Secondary	West Pictou District	Lyons Brook	Grade 11	June, 1976
Post Secondary (List Chronologically)	Nova Scotia Agricultural College	Truro, N.S.	Dipolma (Eng.)	May, 1982
	Acadia University	Wolfville Nova Scotia	3 yrs. of (Math & English)	April, 1979

3. WORK EXPERIENCE

Duration	Company	Position	Responsibilities
four months	Nova Scotia Agr. Coll. & N.S. Dept. of Mines and Energy	Research Ass.	Develop material for extension education, for a course in sol, greenhouse
one year	West Pictou Forest Owners	Foreman & Power Saw Op.	Planting Trees Silvercultural work
two years	Fillion Slashing	Foreman	Seismic crew looking for oil

Appendix VI-G

Energy Advisor Evaluation Criteria

ENERGY ADVISOR EVALUATION CRITERIA

ADVISOR ______________________ HOMEOWNER ______________________

OBSERVER ______________________ DATE ______________________

		POOR							EXCELLENT		
1.	Initial Contact	1	2	3	4	5	6	7	8	9	10
2.	Reaction to Homeowner Type (i.e. How quickly did advisor adjust to personality of homeowner)	1	2	3	4	5	6	7	8	9	10
		VERY HELPFUL							VERY DIFFICULT		
3.	How difficult was the homeowner?	1	2	3	4	5	6	7	8	9	10

4. Did the advisor follow the established procedure? ______ YES ______ NO

If NO explain ____

____

____

		POOR							EXCELLENT		
5.	Technical Appreciation	1	2	3	4	5	6	7	8	9	10
6.	Dress & Appearance	1	2	3	4	5	6	7	8	9	10
7.	Understanding of Computer Program	1	2	3	4	5	6	7	8	9	10
8.	Familiarity with Equipment Operation	1	2	3	4	5	6	7	8	9	10
9.	Presentation and Explanation of Recommendation	1	2	3	4	5	6	7	8	9	10
10.	Ability to Respond Positively to Homeowners Questions	1	2	3	4	5	6	7	8	9	10

11. Briefly expand on the advisors strengths. ______________________

____

____

12. Briefly expand on the advisors weaknesses. ______________________

____

____

SURVEY TIME ALLOCATION

Introduction & Interview ______ mins.
Survey ______ mins.
Data Entry ______ mins.
Recommendations ______ mins.

APPENDIX VII

TRAINING COURSE

Appendix VII-A

Topic Outlines

TOPIC OUTLINE

DAY 1 (AM) INTRODUCTORY SESSION

TOPIC SPEAKERS

K. Griffiths	CTT
R. Lewis	SNL
A. Dawe	SNL

RATIONALE

The trainees require an opportunity to become familiar with their surroundings and to receive overview information relative to:

a) the background and objectives of the pilot project; and

b) a sample survey to be conducted during Day 2 by members of the project team.

ELABORATION

Upon completion, the trainee will be able to:

- access necessary information on the College;
- recognize project personnel;
- understand the SNL procedures for employees;
- discuss the main objectives of the pilot study;
- ask questions on the sample survey to be conducted on Day 2.

METHODOLOGY

- Welcome by College officials including a short presentation on facilities, rules and regulations.

- Introduction of the ShawMont project team.

- Explanation given of:

  - salaries
  - hours of work
  - timesheets
  - company benefits
  - trainees' job description

- Description of the background to the project and an indication of what will be happening over the training period including briefing on selection criteria and methods for the final four advisors. Students receive schedule of activities for training period.

- Introductory presentation on how to carry out a home energy survey. All equipment required on the survey to be displayed and accompanied by an explanation of its intended use.

TOPIC OUTLINE

DAY 1 (PM)

GOVERNMENT PROGRAMS

TOPIC SPEAKERS

G. Hanrahan	EMR
J. Heringa	DME
D. Driscoll	DME
A. Taylor	DME

RATIONALE

Energy Advisors must be familiar with government assistance programs for energy conservation so that they may inform homeowners of potential funding opportunities which may be available to the homeowner to improve the energy efficiency of the home.

ELABORATION

Upon completion, the trainee will be able to:

- understand the respective eligibility clauses for CHIP and COSP;
- understand the procedure for applying for each grant;
- explain the extent of funding available through each program;
- discuss, in general terms, energy conservation projects conducted or ongoing involving both levels of government.

METHODOLOGY

- Review of grant programs sponsored by EMR explaining coverage including:
  - eligible measures (circulate fact sheets)
  - homeowner grants (circulate literature)
  - Method of Application (circulate forms)
  - limit of applications

- Emphasis to be placed on the importance of familiarity with existing programs including possible changes such as eligibility and grants.

- Circulate various EMR produced support literature and explain importance of using material as back-up resource when explaining program to the homeowner.

- Review how available grants differ from region to region in Canada and explain these differences in general terms.

- Review various energy conservation and conservation demonstration programs sponsored by Department of Mines and Energy. Emphasis placed on residential programs.

- Present information on Newfoundland and Labrador housing stock:
  - types
  - number
  - location

- Present slide show giving examples of energy conservation measures that may lead to moisture problems to make students initially aware of possible ramifications of energy retrofit decisions.

TOPIC OUTLINE

DAY 2 (AM) HOME SURVEY

TOPIC SPEAKERS

A. Dawe	SNL
M. Warren	SNL

RATIONALE

Trainees must be thoroughly familiar with the procedure for carrying out an energy survey, therefore it is essential that survey techniques be shown to the trainees as early as possible. This session will outline the standards and procedures expected from an energy advisor and provide an opportunity to the trainees to identify general areas of weakness in their own approaches by observing ShawMont personnel carrying out a survey.

ELABORATION

Upon completion, the trainee will be able to:

- identify the five principle segments of the survey:
    - Homeowner Introduction;
    - Initial Interview Interaction;
    - Survey Data Collection;
    - Data Findings;
    - Results Presentation.
- appreciate the importance of good communications with the homeowner;
- recognize the various tools used by the energy advisor.

METHODOLOGY

- Conduct a home energy survey using homeowner who has agreed to a small group of students (4) observing.

- Emphasize the importance of the communication skills:

  - to explain;
  - to listen;
  - to advise;
  - to engender trust.

- Advise students to be attentive but unobtrusive during the survey - to imagine themselves as the advisor and take notes as questions arise throughout the audit.

- Introduce the students to methods of measurement:

  - tape;
  - compass;
  - Dedesco furnace analyzer;
  - calculator.

  and to data collection and analysis aids:

  - data form;
  - computer;
  - results sheet.

- Clearly breakdown the survey into distinct, easily identifiable segments:

  - homeowner introduction;
  - initial interview interaction;
  - survey data collection;
  - data entry;
  - results presentation;

TOPIC OUTLINE

DAY 2 (PM) SURVEY DEBRIEFING

TOPIC SPEAKERS	
A. Dawe	SNL
R. Lewis	SNL
D. Stewart	SNL
M. Warren	SNL

RATIONALE

Trainees must be given the opportunity to discuss their reactions to the survey procedures in a setting condusive to discussion and verbal interaction.

ELABORATION

Upon completion, the trainee will be able to:

- interface with the SNL project team and other trainees in a group setting;
- question specific details of the survey procedure;
- discuss the five principle segments of the survey;
- enquire into details of equipment use and survey techniques.

METHODOLOGY

- Enquire as to trainee's feelings about the survey and receive questions, criticisms and comments regarding technique, approach and methods of survey.

- Explain to the group the importance of open discussion and interaction.

- Review all questions from the trainees - taking time to try and ascertain various levels of understanding related to the survey techniques.

- Discuss all queries until a degree of understanding is reached that is compatible with each trainee's experience and knowledge.

- Encourage questions on terminology used, equipment tested and recommendations made.

- Explain limitation of the computer program.

TOPIC OUTLINE

DAY 3 (AM)

S.I. MEASUREMENTS AND TECHNICAL MATERIALS

TOPIC SPEAKERS

J. Hiscock CTT

RATIONALE

The Home Energy Advisor will be in a technical field in which there may be a requirement to read and understand engineering drawings/sketches and specifications.

ELABORATION

Upon completion, the trainee will be able to:

- explain and apply S.I. units of measurement - length, area and volume;
- identify various drawing concepts:
    - Technical Drawing
    - Technical Sketching
    - Multi-views
    - Pictorial Drawings
    - Sections
    - Reproduction Methods
- understand the use of scales;
- understand dimensioning;
- recognize standard construction symbols;
- locate relevant information contained in various construction codes.

METHODOLOGY

- Ascertain what level of knowledge trainees have in S.I.
- Provide the class with standard S.I. terms used in residential construction and some examples of use of the terms in area, volume and length.
- Provide bibliography on useful supplementary texts on metric use in construction.
- Explain types of conversion from Imperial to S.I. measurements taking place in Canada in construction and related fields.
- Explain types of drawings/graphics/drafting and uses in construction and other fields, and applications relevant to the trainees.
- Discuss assembly or section symbols and circulate listing of symbols.
- Hand out literature on standard construction symbols and review house plans with trainees to encourage practical application.
- Review history of scales briefly, explain use of the metric scale and design problems using metric scale for conversions.
- Review briefly the various residential construction codes in Canada and inform trainees of methods of access to the codes, if required.

TOPIC OUTLINE

DAY 3 (PM) CONSTRUCTION TECHNOLOGY (Envelopes)

TOPIC SPEAKER

R. Moody CTT

RATIONALE

Energy Advisors recommending additional materials or alterations to homes must have adequate knowledge of construction technology. This topic is designed to provide a basic understanding of the construction technology of building envelopes.

ELABORATION

Upon completion, the trainee will be able to:

- recognize and classify building envelopes;
- identify common house construction including:
  - roof construction
  - wall construction
  - foundation construction

METHODOLOGY

- Describe and explain examples of housing construction types relating to:
  - height of building and terrain type;
  - attached units, types of attachments and overall structural shape;
  - types of excavations;
  - types of foundations;
  - various wall constructions;
  - floor constructions.
- Demonstrate various types by wide use of sectional views.
- Explain technical terms related to the description of different construction types.

TOPIC OUTLINE

DAY 4 (AM/PM)

AUDIT PROCEDURE
(Computer Use)

TOPIC SPEAKERS

D. Stewart	SNL
A. Dawe	SNL

RATIONALE

Energy Advisors must be confident in the operation of the micro computer in the field. Occasions may arise when the advisor may be required to carry out limited trouble shooting in the field.

ELABORATION

Upon completion, the trainee will be able to:

- recognize the capabilities and limitation of the portable computer in relation to the program;
- understand the fundamentals of data entry;
- identify the types of energy conservation retrofit recommendations produced by the computer.

METHODOLOGY

- Provide students with an overview on how computers operate in general and, in particular, on this program.

- Emphasize need for accuracy in:

  - data collection;
  - transfer to numerical coding;
  - entry of data into computer.

- Allow students to fill out data sheet on house observed during Day 2 and enter information into computer. Record recommendations on form provided and compare recommendations with each other.

- Encourage students to similarly enter their own dwelling, as accurately as possible, in order to gain familiarity with the forms, the computer and its operation and the ensuing recommendations.

- Allow students to make controlled changes in type of data entered into the computer to illustrate the effect on recommendations.

- Provide opportunity for experimentation with computers.

TOPIC OUTLINE

DAY 5 (AM)

S.I. MEASUREMENTS AND MATERIAL THERMAL PROPERTIES

TOPIC SPEAKERS

P. Gamble HC

RATIONALE

To properly assess the potential for minimizing energy losses from a home, the advisor must be aware of the thermal properties of commonly used construction materials.

ELABORATION

Upon completion, the trainee will be able to:

- identify S.I. measurements and their common usage;
- understand the concept of thermal properties;
- identify the thermal properties of common construction materials;
- recommend the correct materials for energy retrofit to attain desired 'R' values.

METHODOLOGY

- Provide trainees with a working knowledge of S.I. base units relative to time, mass, temperature, electrical current, amount of substance, luminous intensity.

- Describe common symbols (s, kg, K, m, A, mol, cd).

- Provide common rules of thumb for S.I. use:

    - use symbols where possible;
    - do not start figures with decimal;
    - group large figures - avoid commas;
    - etc.

- Review other developed units of S.I.

    - force
    - pressure
    - torque
    - density
    - work
    - energy
    - power

- Acquaint trainees with relative resistance to heat flow of various materials.

TOPIC OUTLINE

DAY 5 (AM) C.G.S.B. INTRODUCTION

TOPIC SPEAKER

R. Goosney CTT

RATIONALE

The quality of insulating materials and construction materials in general, as well as their installation is governed and regulated by the Canadian General Standards Board (C.G.S.B). When making recommendations for energy retrofit in the home, the energy advisor must be aware of C.G.S.B. regulations.

ELABORATION

Upon completion, the trainee will be able to:

- understand the function of C.G.S.B.
- understand the difference between monitored and unmonitored standards;
- carry out an in-depth study of the S.I.-G.P. series of handbooks.

METHODOLOGY

- Provide an overview of the function of C.G.S.B. and distribute a copy of C.G.S.B. manual and appropriate S.I.-G.P. series of handbooks.

- Explain the definition of standards and illustrate the difference between monitored and non-monitored standards.

- Provide information on procedure for insulation installation company to obtain a C.G.S.B. certification (under monitored standards);

  - application;
  - registration;
  - feedback (monitoring stage).

- Explain the responsibilities of certified insulation contractors:

  - bonded salespeople;
  - installer-in-charge and senior estimators;
  - must have minimum standards
  - minimum liability insurance required;
  - claims fund for non-performance;
  - internal quality control;
  - standards on quotes and contracts.

TOPIC OUTLINE

DAY 5 (PM) INTRODUCTION TO DOMESTIC HOT WATER HEATING SYSTEMS

TOPIC SPEAKER

L. Warren CTT

RATIONALE

The use of energy for producing hot water in the home has significant potential for savings. Previous studies have shown that retrofit measures on domestic hot water systems can effectively reduce energy use.

ELABORATION

Upon completion, the trainee will be able to:

- understand the principle of operation for residential hot water heating systems;
- identify all DHW consumers in a home;
- recognise all potential areas for energy retrofit on residential DHW systems;
- recognize important control devices related to DHW heating systems.

METHODOLOGY

- Explain domestic hot water heating systems and review terminology associated with these types of heating systems to familiarize the trainees with it:
  - flow control valve;
  - indirect water heater;
  - sediment faucet;
  - pressure relief valve, etc.
  - electric elements;
  - thermostats.
- Distribute literature descriptions of above items.
- Discuss importance of pressure reducing valves and pressure and temperature relief valves.
- Explain retrofit options for DHW systems.
- Outline statistics on water consumption associated with typical hot water consumers in the home.

TOPIC OUTLINE

DAY 6 (AM) ELECTRICAL GRID POWER

TOPIC SPEAKER

C. Bursey NLH

RATIONALE

To answer questions relating to demand and fuel adjustment charges as well as recognizing the importance of conserving electricity from a utility point of view, it is important to provide the Advisor with technical information pertaining to the Newfoundland electrical grid.

ELABORATION

Upon completion, the trainee will be able to:

- identify methods of generating electricity;
- identify the costs associated with generating electricity;
- know the location of generating stations;
- discuss the present and future electrical requirements of Newfoundland and Labrador.

METHODOLOGY

- Provide a general overview of the power grid system in Newfoundland and Labrador:
  - include generating stations into production and projected;
  - give capacity of each station and total grid capacity;
  - review how oil-fired generation at Holyrood fits into grid (subsidizing payments, etc.);
  - mention other contributors to grid.

- Discuss remote coastal communities and their special circumstances:
  - how the circumstances were handled;
  - projections/plans - upgrading diesel generators;
    - mini-hydro generators;

- Discuss potential for hydro generated electricity in the province:
  - Island fully exploited;
  - Labrador resources:
    - historical/political difficulties with existing sites;
    - projection for new projects;
    - funding difficulties;
    - transmission requirements.

TOPIC OUTLINE

DAY 6 (AM)   HOME USE OF ELECTRICTY   TOPIC SPEAKER

P. Hamilton   NLP

RATIONALE

Approximately 30 percent of the Provincial Housing Stock uses electricity for 100% of its total energy requirement. The Advisor must be able to quantify electrical consumption for individual consumers and be able to identify energy conservation opportunities.

ELABORATION

Upon completion, the trainee will be able to:

- identify and quantify household consumers;
- Discuss information on the wise use of electricity;
- present information to homeowners on guidelines for energy efficient homes (as per Canadian Electrical Association).

METHODOLOGY

- Provide information on various aspects of Light & Power's systems:
  - hydro-generated;
  - thermal (oil produced);
  - electric;
  - industrial;
  - residential/commercial.

- Distribute pamphlets concerning:
  - NLP/Canadian Electrical Association Energy Use Program.
  - various energy saving devices and methods.

- Present an electrical consumption breakdown for a typical home, and what % of heat gain is received from each source/user.

  SOURCE/USER

  - space heating
  - free heat (major appliances)
  - lights, small appliances
  - DHW heating

- Provide tips to trainees when dealing with NL&P consumers:
  - compare bills in KWH not dollars;
  - line voltage thermostats inaccurate vs. low-voltage ones;
  - consider basic customer charge;
  - use major users of electricity in home in off peak hours, where possible.

TOPIC OUTLINE

DAY 6 (PM)

CANADA MORTGAGE AND HOUSING CORPORATION

TOPIC SPEAKER

M. Woodman CMHC

RATIONALE

Energy advisors must be familiar with government assistance programs in order to inform homeowners of possible funding which may be available to them through CMHC to upgrade the structural and living standard of their home (and indirectly the energy efficiency).

ELABORATION

Upon completion, the trainee will be able to:

- identify the eligibility clauses for the Canadian Home Renovation Program (CHRP);
- understand the extent of funding available through CHRP;
- explain the procedure for applying for a CHRP grant.

METHODOLOGY

- Provide general overview of all CMHC programs available to homeowners/potential homeowners/other under the National Housing Act.
- Emphasis on CHRP loan/grant combinations and home improvement loans.
- Explain funding available under the programs including forgiveable portions and conditions, etc.
- Distribute various pamphlets to trainees on various programs and explain application forms and application procedures.

TOPIC OUTLINE

DAY 6 (PM)

COMMUNICATIONS - SESSION 1

TOPIC SPEAKER

E. Reynolds CTT

RATIONALE

The development of good communication skills is essential for the success of the residential energy advisors. The advisors must be able to engender trust between the homeowner and themselves. The ability to listen effectively is a concept that must be realized and understood by the trainees.

ELABORATION

Upon completion, the trainee will be able to:

- discuss the basic principles of effective public communications;
- understand the importance of listening attentively.

METHODOLOGY

- Familiarize students with basic principles of effective public communications:
    - remembering details, i.e. someone's name;
    - making and maintaining eye contact;
    - listening.
- Discuss various interpretations of "communications".
- Distribute literature to trainees on communications and on listening.

TOPIC OUTLINE

DAY 7 (AM)

HOME AUDIT
(Empty House)

TOPIC SPEAKERS

A. Dawe	SNL
M. Warren	SNL
D. Stewart	SNL

RATIONALE

The residential energy advisor must be given an opportunity to practice and develope their audit delivery skills. This development is best accommodated by auditing empty houses in which students are free to roam through the home with experienced personnel on hand to answer questions or give instruction.

ELABORATION

Upon completion, the trainee will be able to:

- collect data from the home;
- use all necessary equipment required for residential home surveys;
- practice role playing and communication skills with fellow trainees;
- fill out the computer data sheet;
- enter data into the computer;
- analyse computer recommendations for the home.

METHODOLOGY

- Provide a suitable empty house for trainees to do their first full scale audit.

- Put all trainees in pairs and have them role play advisor and homeowner - have sufficient data "invented" by each team in advance to take the place of certain homeowner provided information.

- Trainees should go through previously established routines in interviewing and collecting data from the house.

- Trainees should use all necessary equipment to do a full scale energy audit, obtaining as much factual information as possible.

- The homeowner/advisor situation should be simulated on through the entering of data into the computer and throughout the writing and presentation of the ensuing recommendations.

TOPIC OUTLINE

DAY 7 (PM)	AUDIT DEBRIEFING	TOPIC SPEAKERS

A. Dawe	SNL
M. Warren	SNL
D. Stewart	SNL

RATIONALE

Trainees should be provided an opportunity to ask and receive answers to questions pertaining to the morning survey.

ELABORATION

Upon completion, the trainee will be able to:

- ask specific questions on activities carried out during the morning audit;
- provide constructive criticisms on individual techniques and methods employed for the collecting of data;
- elaborate on recommendations made by the computer.

METHODOLOGY

- Receive constructive criticism, especially re. communicative skills, from trainees who role played homeowners in morning survey of the trainees they were with.
- Encourage self-analysis by individuals who were advisors in morning session.
- Provide constructive assessment re. procedures, techniques used in the morning and suggestions for improvements.
- Discuss questions that arose from morning's survey on prior audit (experience).
- Explain recommendations that were produced by computers after input of pertinent data.
- Compare differences in recommendations, between the four groups, if any, and analyze how and why these differences occurred.
- Summarize the afternoon's discussions and re-emphasize the principal elements of the survey.

TOPIC OUTLINE

DAY 8 (AM) HEAT THEORY

TOPIC SPEAKER

P. Gamble HC

RATIONALE

It is essential that the advisor has a working knowledge of the laws of thermodynamics and understands the general mechanics of heat transfer and the methods of its control, in order to identify and make recommendations on potential energy conservation retrofit.

ELABORATION

Upon completion, the trainee will be able to:

- explain heat flow by conduction, convection and radiation;
- recall the principles of heat flow through materials;
- identify ways of controlling or minimizing heat transfer.

METHODOLOGY

- Provide trainees with a working knowledge of heat energy and associated terminology.

  - indicate difference between heat/temperature
  - indicate difference between latent heat/sensible heat.

- Discuss heat flow/heat transfer

  - conduction
  - convection
  - radiation
  - provide explanation and formulae for each.

- Set problems to be solved by trainees

  - energy needed to heat DHW
  - cost of energy needed to heat DHW
  - conductive heat loss through building materials
  - heat loss "standby" of DHW tank.

TOPIC OUTLINE

DAY 8 (PM) OIL FIRED HEATING UNITS TOPIC SPEAKER

R. Cotter EMR

RATIONALE

Approximately 30% of the provincial housing stock use an oil-fired unit to meet space heating requirements. Improperly used and maintained, these units can waste large quantities of energy. The energy advisor must be trained to identify energy conservation opportunities during unit inspection.

ELABORATION

Upon completion, the trainee will be able to:

- compare different methods of home space heating;
- identify different models of furnaces/boilers;
- recognize furnace/boiler controls and locations;
- identify furnace/boiler components.

METHODOLOGY

- Present audio-visual and written literature on components of warm air heating systems and their functions.

- Inspect disassembled oil burner units
  - illustrate different types of burners;
  - explain how the burner functions;
  - explain combustion principles and retrofit and maintenance procedures re. oil burner units;
  - review flame retention heads.

- Explain the various furnace measurements used to check efficiency.

- Describe different types of warm air furnaces and their applications, advantages and drawbacks.

- Explain purpose of barometric damper on oil fired systems.

- Explain regular maintenance procedures.

- Describe location and function of limit controls.

- Preview recent developments affecting oil-fired heating systems retrofits
  - positive flue damper;
  - programmable thermostat;
  - Enertrol.

TOPIC OUTLINE

DAY 9 (AM) CONSTRUCTION TECHNOLOGY (Components)

TOPIC SPEAKER

J. Hiscock CTT

RATIONALE

The residential energy advisor must be familiar with the common building materials used in residential construction. Such knowledge is essential when making recommendations for energy retrofit in the home.

ELABORATION

Upon completion, the trainee will be able to:

- recognize common building materials;
- identify common construction techniques for:
  - walls;
  - ceiling;
  - roofs;
  - foundations.
- identify common insulating materials on the market;
- describe proper methods for installing insulation and vapour barriers;
- understand methods for selection and installation of weatherstripping and caulking materials.

METHODOLOGY

- Provide trainees with a listing of the common construction materials used in Newfoundland Housing Stock.
- Illustrate, using scale models, how these materials are typically used in the construction industry.
- Distribute samples of all insulation materials available for use in Newfoundland Housing Construction.
- Provide instruction on the proper selection and installation of construction materials.
- Demonstrate the installation of weatherstripping and caulking materials

TOPIC OUTLINE

DAY 9 (PM)

FIRE CODES AND PREVENTION

TOPIC SPEAKER

W. Drover FMO

RATIONALE

The energy advisor will be in a position in which he/she will be inspecting homes and making recommendations for modifications and improvements to structures and systems. It is important that the advisor be trained to recognize both potential fire hazards in existing homes as well as make recommendations for energy retrofits which are acceptable under the local fire codes.

ELABORATION

Upon completion, the trainee will be able to:

- discuss the common causes of fire in a home:
  - cooking equipment;
  - heating equipment;
  - electrical equipment and circuits.
- explain home fire prevention rules;
- locate the National Building and Fire Codes of Canada:
  - CMHC residential standards;
  - plumbing code;
  - installation code for oil burning equipment;
  - installation code for propane burning equipment;
  - installation code for solid-fuel burning appliances and equipment.
- understand fire resistance rating and flame spread rating.

METHODOLOGY

- Give out factual literature on fire causes and prevention in residential properties.

- Include information on the types or classes of possible fires and how they differ.

- Review building codes as they pertain to fire safety in construction:
  - (CMHC) Residential Standards;
  - Plumbing Code;
  - Supplement to the Building Code.

- Review various standards that are or will be legislated as law in Newfoundland and Labrador to be followed in the home in the areas concerned:
  - CSA Standard B139 - Oil Burning Equipment Installation Code;
    - CAN1 B149-2 - Propane Burning Appliances and Equipment Installation Code;
    - B 365 - Solid Fuel Burning Appliances and Equipment Installation Code.

- Familiarize students with terminology associated with fire safety in construction:
  - fire separations;
  - fire walls;
  - party walls;
  - pyrolysis;
  - fire resistance ratings;
  - flame spread ratings.

TOPIC OUTLINE

DAY 10 (AM) HOME AUDIT (Computer)

TOPIC SPEAKERS

D. Stewart	SNL
A. Dawe	SNL

RATIONALE

The computer is probably the most complex piece of equipment which the energy advisor will have to operate and understand during a survey. To obtain accurate estimates of potential savings it is essential that the trainees have a basic understanding of the program software as well as the data which must be collected from the survey. The trainees should be provided with instruction as well as an opportunity to ask questions on the use of the computer.

ELABORATION

Upon completion, the trainee will be able to:

- operate the computer in the field to:
  - log in procedures;
  - use the floppy disks;
  - care and maintenance.
- discuss the basic working of the software:
  - history of the development;
  - modifications made to the program;
  - analysis of data;
  - explanation of terminology;
  - general description of the program;
  - de-bugging procedures;
- complete the computer data sheet:
  - terminology;
  - range of responses per question;
  - correct method for recording data;
  - default values and critical data entry.

METHODOLOGY

- Session will be conducted as an empty house audit.
- Maintain the trainees groupings that were established during the previous survey but reverse roles of advisor and homeowner.
- At this point all students have been given:
    - a run-down on the origin of the software program, its evolution and an idea of where the program stands in terms of the project nationally.
- Explain how calculations are made by the computer, using certain assumed information.
- Explain the limitation of the program, ways to circumvent unforeseen difficulties in the field, and the need for ongoing evaluation of the software.
- Students to practice use of computer under direct supervision.

TOPIC OUTLINE

DAY 10 (PM)

SPACE HEATING WITH AUXILIARY EQUIPMENT

TOPIC SPEAKER

L. Warren CTT

RATIONALE

As energy costs continue to rise, more and more people are using auxiliary equipment such as kerosene heating and oil space heaters to offset the cost of heating their homes. In some cases, this auxiliary equipment can account for a significant percentage of the overall space heating requirements. It is therefore important that the advisor can recognize and, where applicable, account for the relative contribution of such equipment when predicting the energy costs for a home as well as potential saving through retrofit.

ELABORATION

Upon completion, the trainee will be able to:

- identify the different types of auxiliary space heating equipment available;
- locate data on how each piece of equipment works;
- understand the correct procedures for installation;
- understand safety requirements for each unit;
- discuss the advantages and disadvantages of using auxiliary space heating equipment over conventional systems.

METHODOLOGY

- Present a list of possible types of auxiliary heating that advisors are likely to encounter and provide explanations of each.

  These include:

  - older vaporizer - type stove;
  - kerosene heaters - convection type
    - radiation type
    - combination of above two

- Distribute literature on safety reports for kerosene heaters (most popular form of auxiliary heat).

- Review installation of the above for the safety aspects.

- Discuss apparent advantages and disadvantages of these types of heaters:

  - safe storage
  - health factors
  - costs.

TOPIC OUTLINE

DAY 11 (AM)

CANADIAN GENERAL STANDARDS BOARD (C.G.S.B.)

TOPIC SPEAKER

P. Gamble HC

RATIONALE

Due to the extensive amount of relevant material available through CGSB, an extra session will provide the opportunity for a more detailed evaluation of this topic within the program.

ELABORATION

Upon completion, the trainee will be able to:

- calculate heat loss through building assemblies with varying 'R' values;
- search the S.I.-G.P. handbooks for appropriate information.

METHODOLOGY

- Provide examples of typical building assemblies so the students can list total 'R' values for walls, etc. using information learned in CGSB manual on 'R' values of materials, including air films.
- Present various problematic questions on the calculation of heat loss through these building assemblies.

TOPIC OUTLINE

DAY 11 (PM)

ELECTRICAL WIRING AND APPLIANCES

TOPIC SPEAKER

P. Gamble HC

RATIONALE

A basic understanding of how electricity is distributed throughout the home is essential, in particular, the ability to spot potential safety hazards. It is important for the advisor to recognize the relative consumption of energy by different electric appliances. As such, areas can be identified where homeowners may operate home appliances more efficiently.

ELABORATION

Upon completion, the trainee will be able to:

- understand the rationale of codes and regulations which apply to residential wiring;
- identify obvious potential electrical safety hazards;
- discuss generally how electrical appliances work and how they consume energy.

METHODOLOGY

- Provide trainees with basic knowledge of electrical energy and associated terminology:
  - electrical force;
  - electrical rate of flow;
  - electrical impedance;
  - electrical energy;
  - electrical power.

- Give examples (i.e. DHW tank) to illustrate the above and formulae associated with each.

- Present an overview of types and methods of electricity production with emphasis on the magnetic or generation method of production and ways to produce this:

  - diesel oil;
  - thermal;
  - hydro;
  - nuclear.

- Explain operation/use of generators, motors, transformers.

- Explain AC/DC transmission of electrical power.

- Explain set-up of home service including:

  - meter use/operation;
  - main switch/fuses;
  - distribution/fuses/breakers;
  - circuitry/wiring.

- Present problems to solve on meter operation and associated calculations - also problems involving use of electricity - e.g. cost of lighting a room, drying load of clothes,, etc.

- List the many appliances, etc. in the home and explain use patterns and relative consumption of electricity of each.

TOPIC OUTLINE

DAY 11 (PM) COMMUNICATIONS - SESSION 2 TOPIC SPEAKER

E. Reynolds CTT

RATIONALE

The ability to conduct interview correctly is best understood when it is realized that the interview is an interactive process requiring the interviewer to be constantly aware of the feelings of the listener so as not to annoy the interviewee by ones domination of the interview. The interview is an essential ingredient of a successful home energy survey.

ELABORATION

Upon completion, the trainee will be able to:

- display a confident yet friendly interview manner to other trainees;
- identify problem areas in an interview:
  - too difficult a question;
  - wrong reply (according to the interviewer);
  - loss of interest in particular topic.
- open and close an interview in an appropriate manner.

METHODOLOGY

- Review with trainees proper dress for doing audits and its function in affecting people's impressions.

- Do role playing situation to familiarize students with possible types of people that will be encountered and how to deal effectively with various situations.

- Practice initial part of audit, in turn, until each student is comfortable with an approach that is acceptable to instructor and other students, who provide constructive criticism.

TOPIC OUTLINE

DAY 12 (AM) HOME AUDIT (Empty House)

TOPIC SPEAKERS	
A. Dawe	SNL
M. Warren	SNL
D. Stewart	SNL

RATIONALE

The residential energy advisor must be given an opportunity to practice and develop survey delivery skills. This development is best accommodated by surveying empty houses in which trainees are free to roam through the home with experienced personnel on hand to answer questions and given instructions.

ELABORATION

Upon completion, the trainee will be able to:

- refine methods for collecting data from the home;
- use, with confidence, all necessary equipment required for residential home surveys;
- identify key elements of the communications skill necessary for a successful survey;
- complete the computer data sheet, accurately enter data into the computer;
- analyze computer recommendations for the home.

METHODOLOGY

- Supply suitable house for audits to be performed.
- Choose rearranged pairs of trainees to involve in role playing and performing the audit.
- In this arrangement, trainees should collect pertinent data using all available and necessary equipment.
    - interview "homeowner" to gather information pertaining to living patterns and to practice communications skills;
    - record all data on form supplied in the prescribed order;
    - using required amount of care and skill, enter data into computer and list results as they are produced on form supplied;
    - analyze these results and practice reviewing them with mock homeowner.

TOPIC OUTLINE

DAY 12 (PM) AUDIT DEBRIEFING

TOPIC SPEAKERS	
A. Dawe	SNL
M. Warren	SNL
D. Stewart	SNL

RATIONALE

Trainees should be provided with an opportunity to ask and receive answers to questions pertaining to the morning survey.

ELABORATION

Upon completion, students will be able to:

- discuss in detail activities carried out during the morning survey;
- provide constructive criticism on individual techniques and methods employed for collecting data during the mornning survey;
- elaborate on recommendations made by the computer.

METHODOLOGY

- Receive constructive criticism, especially re. communicative skills, from students who role played homeowners in morning survey of the students they were with.
- Encourage self-analysis by individuals who were advisors in morning session.
- Provide constructive and assessment re. procedures, techniques used in the morning and suggestions for improvements.
- Discuss questions that arose from morning's survey on prior audit (experience).
- Explain recommendations that were produced by computers after input of pertinent data.
- Compare differences in recommendations, between the four groups, if any, and analyze how and why these differences occurred.
- Summarize the afternoon's discussions and re-emphasize the principal elements of the survey.

TOPIC OUTLINE

DAY 13 (AM)

DOMESTIC HOT WATER CONSUMPTION

TOPIC SPEAKER

P. Gamble HC

RATIONALE

Energy used to heat domestic hot water can account for a significant percentage of the total energy used in the home. It is important for the trainees to be familiar with the different methods for heating water as well as be able to make recommendations on ways to reduce hot water consumption and/or heat water more efficiently.

ELABORATION

Upon completion, the trainee will be able to:

- identify the different methods of heating water;
- understand the operation of appliances which consume domestic hot water;
- recognize the potential for reducing hot water consumption in each home.
- explain the operation of flow restrictors and other domestic hot water conservation products.

METHODOLOGY

- Describe the systems available for heating hot water in Newfoundland.
- Outline the different components required in each system and the factors which affect their use.
- Provide comparison between the systems available highlighting the relative energy efficiency of each system.
- Describe in detail, retrofits and conversions which can be applied in each system to improve the overall energy efficiency.
- Demonstrate the operation of the different systems in a practical laboratory session.

TOPIC OUTLINE

DAY 13 (PM)

TECHNICAL MATERIALS AND INTERPRETATION

TOPIC SPEAKER

J. Hiscock CTT

RATIONALE

The trainees must be familiar with the common materials used in the construction industry as well as the different methods and techniques for installing them. The advisor will require this information when making recommendations for energy retrofit.

ELABORATION

Upon completion, the trainee will be able to:

- recognize common construction materials used in Newfoundland;
- identify and describe the common methods for installing construction materials;
- read blueprints and be able to obtain information from them;
- use scales and produce drawings;
- recognize common symbols and legends used on blueprints.

METHODOLOGY

- Provide trainees with a listing of the common construction materials used in Newfoundland Housing Stock.
- Provide the trainees with drawings which outline typical construction details.
- Instruct trainees on how to read blueprints and be able to identify and use common symbols and legends in use throughout the construction industry.
- Visit to residential construction site in which there are homes under different stages of construction.

TOPIC OUTLINE

DAY 14 (AM & PM)

DEMONSTRATION/
SITE VISIT DAY

TOPIC SPEAKERS

A. Dawe	SNL
D. Stewart	SNL
R. Lewis	SNL

RATIONALE

By this time in the course, the students will have received approximately 3 weeks of intensive training and are quite susceptable to an "information overload" problem. An opportunity is provided for the students to receive training in an informal and relaxed atmosphere to break from their normal routine.

ELABORATION

Upon completion, trainees should have been given an opportunity to visit field sites which demonstrate residential energy conservation.

METHODOLOGY

AM

- Visit energy efficient demonstration home in Torbay.
- Carry out detailed inspection of construction techniques, types of appliances and methods for monitoring energy usage.
- Carry out group discussions with the homeowner.

PM

- Guided tour of industrial facility.
- Emphasize the large amounts of electricity, hot water, oil, etc., that are being used in this location.
- Review steps company has taken to reduce waste and conserve energy and save money.
- Ask for suggestions as to what other measures might be taken to control wastage and to conserve energy, either through retrofits or new programs.

TOPIC OUTLINE

DAY 15 (AM)

HEAT FLOW
(Infiltration and Ventilation)

TOPIC SPEAKER

P. Gravelle HSL

RATIONALE

One of the major sources of heat loss in the home is infiltration. It is important for the trainees to understand the concept of heat flow by infiltration and ventilation so that they may identify potential energy conservation retrofits for the homeowner.

ELABORATION

Upon completion, the trainee will be able to:

- understand the basic concepts of heat flow by infiltration and ventilation;
- identify areas in the home where infiltration and ventilation occurs;
- recognize products on the market which can be used in energy retrofits to minimize energy loss through infiltration;
- describe the proper applications and selection of the products;

METHODOLOGY

- Provide trainees with a basic knowledge of air leakage in buildings - its causes and ways to prevent it.

- Infiltration/exfiltration is explained to students and what factors affect it:

  - pressure differences
  - wind speed
  - temperature differences
  - convection

- Use, as examples, various types of residential construction to illustrate the principles associated with air leakage:

  - neutral plane
  - stack or chimney effect
  - air changes (usually measured per hour)

- Show trainees types of sealants and weatherstripping materials to seal up around residential construction.

- Explain reason for the air tightness of the inside of the structure to be much greater than that of the outside.

- Present to trainees products/services available which can help illustrate air leakage before and after sealing the interior of a house.

- Familiarize trainees with applicable sections of CGSB manual re. air infiltration:

  - 5.1 Heat Losses Canadian Buildings
  - 5.2 Air Leakage Spots in Conventional Construction

TOPIC OUTLINE

DAY 15 (PM)

ENERGY SAVING COMPONENTS AND THEIR APPLICATION

TOPIC SPEAKER

P. Gamble HC

RATIONALE

As the price of energy escalates, an ever-increasing number of energy conservation products are being made available to the consumer. It is important for the students to be familiar with these products and their proper application in order to be able to make recommendations for their proper use.

ELABORATION

Upon completion, the trainee will be able to:

- recognise different types of energy conservation products available in the area;
- describe the proper application for the products;
- quantify the saving to be expected by using the product;

METHODOLOGY

- Make available pictures, brochures or samples of as many types of retrofit and conservation products as possible.

- Instruct trainees as to the correct methods to apply or use these products and to what part(s) of a dwelling that they are suited.

- Explain relative reductions in air leakage due to certain measures being taken and accordingly energy savings to consumers based on consumption.

TOPIC OUTLINE

DAY 16 (AM)

HOMEOWNER EDUCATION PACKAGE

TOPIC SPEAKER

P. Hearn SNL

RATIONALE

In order for a communication program to be effective, provision must be made for visual materials to assist the advisor to explain and the homeowner to understand the concepts of residential energy awareness and methods to improve home energy efficiency.

ELABORATION

Upon completion, the trainee will be able to:

- describe the process of homeowner communication for this project:
  - Pre-survey Brochure
  - Homeowner Information Kit
  - Follow-up Package
- discuss each element of the Homeowner Information Kit:
  - COSP Brochure
  - CHIP Brochure
  - Survey Results Form
  - Cornerstones Energy Savings Guide
  - Recommendations Sheet

METHODOLOGY

- Presentation to trainees of information package to be presented to homeowners at conclusion of audits and also post-audit follow-up information required by homeowners to make informed decisions about retrofits.
- Explanation and evaluation of each individual piece of literature available to be given to homeowners.
- Emphasis on homeowner understanding what is being given to her/him, especially in the case of the recommendation sheet.
- Also, emphasis on full understanding of applicable EMR grants and conveying this understanding to the homeowner, at the same time answering any questions he/she has about the programs.

TOPIC OUTLINE

DAY 16 (PM) PRESERVED BASEMENTS

TOPIC SPEAKER

L. Walker WE

RATIONALE

Preserved basement construction is a new concept in Newfoundland, however, its popularity is growing. Trainees should be familiar with this technology to answer any questions from homeowners.

ELABORATION

Upon completion, the trainee will be able to:

- describe the advantages and disadvantages of preserved basement technology - strength - durability - water repellent properties;
- identify the energy conservation characteristics of concrete versus preserved wood foundations;
- discuss the economics of concrete versus wood preserved foundations.

METHODOLOGY

- Explain to trainees methods of manufacturing and installing preserved wood foundations.

- Explain relative R-value of pressure treated plywood and concrete.

- Indicate comfort differences between two types of construction.

- Explain relative costs for similar or identical size construction using the two types of basement foundation.

- Explain method of installing preserving compound on the plywood and also method of making wood more impervious to moisture below grade with polyethylene or liquid plastic.

TOPIC OUTLINE

DAY 16 (PM) COMMUNICATIONS - SESSION 3 TOPIC SPEAKER

E. Reynolds CTT

RATIONALE

Having experimented with various types of interview techniques, more practice is necessary to hone the required skills for the field surveys. Self criticism is an important step in making positive changes to mannerisms that may impede good communications.

ELABORATION

Upon completion, the trainee will be able to:

- analyze objectively, his/her interview technique;
- effect changes to the interview technique to improve it.

METHODOLOGY

- Do role playing situations for full length audit utilizing audio-visual equipment for feedback:

  - give self criticism of interview seen on tape;
  - have instructor/classmates provide constructive criticism.

TOPIC OUTLINE

DAY 17 (AM)

HOME AUDIT
(Full Student Lead)

TOPIC SPEAKERS

A. Dawe	SNL
D. Stewart	SNL
M. Warren	SNL
P. Hearn	SNL

RATIONALE

Having practiced and developed their delivery skills in an "empty house" situation the trainees must be given the opportunity to practice the delivery of a survey in realistic situation under the observation of supervisory personnel.

ELABORATION

Upon completion, the trainee will be able to:

- deliver a complete audit to a homeowner including:
    - initial introduction and explanation of the project;
    - collection of pertinent data from the home;
    - completion of the data sheet;
    - data entry into the computer;
    - completion of all required forms;
    - explanation of recommendations to the homeowner.

METHODOLOGY

- Arrange for homeowner occupied houses for full scale audit.
- Have four groups of supervisor, student observer and trainee advisor conduct full scale audits.
- Ensure that the trainee advisors know that they are in charge of the survey and not the supervisor. Supervisor will only comment if a major problem cannot be resolved.
- Observe advisors methods and interaction with the homeowner. Record any points for further discussion.

TOPIC OUTLINE

DAY 17 (PM) AUDIT DEBRIEFING

TOPIC SPEAKERS

A. Dawe	SNL
D. Stewart	SNL
M. Warren	SNL
P. Hearn	SNL
R. Lewis	SNL

RATIONALE

Immediately after the practice surveys, the trainee should be given the opportunity to discuss in detail their work and to receive constructive criticism on techniques and methods employed in collecting, analyzing and relaying information.

ELABORATION

Upon completion, the trainee will have been given an analysis of his/her performance during the survey. The supervisor will have noted both weak and strong points in the trainees delivery and have made suggestions on ways to improve techniques and methods for collecting and analyzing data.

METHODOLOGY

- Debriefing session is held with all participants of morning audits.
- Allow self-analysis by the trainee advisor. Points raised will be discussed and questions answered.
- Student observers make criticism/comments of a constructive nature from their notes about the morning's audits.
- Supervisors then elaborate on earlier points that were raised and makes suggestions to/criticisms of the audit procedure, as it was conducted.

TOPIC OUTLINE

DAY 18 (AM & PM)

MOISTURE PROBLEMS IN HOMES

TOPIC SPEAKERS

J. Heringa	DME
B. Platts	SC
D. Morris	CMHC

RATIONALE

Severe structural damage to a home can occur after energy retrofits have been carried out if proper precautions are not taken. The trainees must be able to recognize signs of moisture damage and make recommendations which will either assist in correcting an existing problem or prevent possible damage from occurring.

ELABORATION

Upon completion, the trainee will be able to:

- describe the common causes for moisture build-up in the home;
- identify potential sources of moisture;
    - moisture in electrically heated homes;
    - correction of moisture problems:
        - surface condensation
        - concealed condensation
    - moisture problems in "tight" house construction;
- explain recommendations to help correct or prevent moisture related damage.

METHODOLOGY

J. Heringa

- Present audio visual material illustrating moisture damage to local housing stock:
    - illustrate what potential for damage is;
    - show that serious damage can be concealed for long periods of time;
    - stress that, in many cases, serious damage has occurred in very recently built houses;
    - address ways to prevent moisture build-up in new construction;
    - indicate need to be very careful when making energy retrofit suggestions as these must be made with possible moisture damage in mind.

B. Platts

- Present to trainees that although energy conservation and retrofit programs and awareness are relatively new on a large scale an even more recent problem is on the horizon and looming ever larger - moisture damage.

- Also, make known that there is no one school of thought on causes or cures for the problem.

- Have trainees consider and be aware of the four basic parameters to judge a house and its potential for or present moisture damage:
    - amount of moisture generation;
    - exfiltration vs. infiltration (and changes in this)
    - air changes (and changes in this)
    - envelope leaks from house interior.

D. Morris

- Make trainees aware of air exfiltration through building materials:
    - use R value of wall assembly materials to obtain temperature of each component given outside and inside temperatures - this will give point where dew point and condensation will occur.

- Give trainees indication of local conditions of factors affecting air leakage in houses:
    - Newfoundland has highest wind speeds in Canada;
    - Newfoundland has highest gust of wind in Canada;
    - Newfoundland has highest severity index for all wind directions, except Easterly, in Canada;
    - highest mean in Canada for days with measureable rainfall.

TOPIC OUTLINE

DAY 19 (AM) RETROFIT OPTIONS

TOPIC SPEAKER

H. Katzin IBI

RATIONALE

For existing construction, the homeowner is limited in the number of energy conservation retrofits which he can "economically" carry out in the home. It is important for the advisor to be able to recognize all the potential energy retrofits which may apply to the home.

ELABORATION

Upon completion, the trainee will be able to:

- describe all the different potential energy retrofits which can be applied in existing residential construction including:
  - modifications to structural components to increase R value;
  - modifications to the home to reduce air infiltration;
  - modification to the home to improve space heating and domestic hot water systems.
- identify major and minor retrofits including:
  - an estimate of the cost of the job (using the computer);
  - an estimate of the saving through the retrofit (using the computer).

METHODOLOGY

- Present trainees with description of all retrofit options that computer has at its disposal to display as recommendations:

  - explain what each recommendation uses as a basis for being displayed or not;
  - be aware that there are major groupings of possible recommendations:
    - increasing R values of components of structure;
    - reducing air infiltration;
    - heating system improvements/changes;
    - hot water system improvements/changes;
  - Describe how each of the possible retrofit options offered affect any of the others and savings thereof.

- Explain probable costs and savings associated with all retrofit options (based on current conditions of structure and students' awareness of how this affects energy consumption together with the students' knowledge of the computer software).

TOPIC OUTLINE

DAY 19 (PM)

COLLECTING AND ANALYZING FIELD DATA

TOPIC SPEAKERS

A. Dawe	SNL
D. Stewart	SNL

RATIONALE

The accuracy of the prediction made by the computer for saving and recommendations depend directly on the quality and accuracy of the field data collected by the advisor. Reinforcement of the principles of collecting and analyzing field data is essential.

ELABORATION

Upon completion, the trainee will be able to:

- understand the different types of data required by the computer program;
- discuss the techniques and methods for collecting accurate data:
  - during the initial homeowner interview;
  - from different equipment provided for the survey;
  - from the home survey;
  - from information provided by the homeowner.
- analyze data from the computer print out and determine the relative accuracy with respect to the home being surveyed.

METHODOLOGY

- Trainees encouraged to ask any questions re. data collection:
  - including homeowner interview;
  - measurement and testing procedures;
  - other information obtained via the homeowner.

- Troubleshoot any problems trainees are having entering valid data into computer and obtaining viable recommendations.

- Trainees encouraged to judge recommendations received on prior surveys to see if procedures have been followed and if they are having problems understanding the intent or consequence of any recommendations.

TOPIC OUTLINE

DAY 20 (AM) WIND ENERGY

TOPIC SPEAKER

B. Kelland CTT

RATIONALE

Newfoundland and Labrador is geographically positioned such that it experiences considerable wind in all seasons. The energy of the wind can be put to immediate useful work or it can be converted and stored for future work. Trainees should have an understanding of this technology to answer basic questions from homeowners.

ELABORATION

Upon completion, the trainee will be able to:

- discuss, in general terms, the following:
  - Wind turbine classification:
    - vertical axis;
    - horizontal axis;
  - storage of energy:
    - lead acid batteries;
    - power grid;
    - water pumping to reservoir;
    - hydrogen production;
    - air storage;
    - fly wheels;
  - research involvement by N.R.C. and other;
  - site location for best results;
  - economics of wind turbines.

METHODOLOGY

- Trainees are instructed in wind turbine classifications and sub-clases:
  - comparisons made between the two classifications - VANT - HANT
- Give definitions and explanations regarding associated terminology:
  - air foils;
  - overspeed controls;
  - output power of wind turbine equation;
  - Betz co-efficient;
  - stall;
  - etc.
- Give relative typical performances of various types of wind machines considering tip speed ratio and power co-efficient.
- Give an idea of costs of typical wind machines and percentages spent on:
  - generator;
  - tower;
  - peripheral equipment (controls, etc.);
  - batteries (where applicable).
- Provide trainees with various possible uses of WECS (Wind Energy Conversion Systems) and storage possibilities:
  - synchronous setup with power grid;
  - batteries;
  - water pumping to reservoir and others being researched;
  - hydrogen production;
  - air storage;
  - fly wheels.

TOPIC OUTLINE

DAY 20 (AM)

HEAT PUMPS AND EXCHANGERS

TOPIC SPEAKER

D. Stewart SNL

RATIONALE

As energy prices escalate, consumers have been investigating other "heating" techniques in an attempt to save on their heating skills. The trainees should have a basic understanding of heat pump and exchanger technology to answer questions from inquisitive homeowners.

ELABORATION

Upon completion, the trainee will be able to:
- Discuss, in general terms, the following:

- heat pump technology:
    - principles of operation;
    - winter heating and summer cooling;
    - installation methods and costs;
    - relative economics.

- residential air-to-air heat exchanger technology:
    - principles of heat recovery;
    - installation;
    - humidity control and fresh air supply relative economics.

METHODOLOGY

- Cover heat pumps sufficiently to give trainees basic knowledge of their purpose and methods of operation:

    - explain electrical resistance form of heating vs. heat pump technology;
    - cover Kelvin temperature scale.

- Review various types of heat pumps and their installation methods:
    - water to air;
    - air to air;
    - water to water;
    - ground to air;
    - ground to water.

- Explain means of measuring efficiency of heat pumps - COP - coefficient of performance.

- Review disadvantage and advantage of present day heat pumps.

- Explain heat exchangers to trainees sufficiently to provide a basis knowledge of the principles under which they operate:

    - air control or management is main purpose for installation;
    - controls pollution, smoke, odours;
    - performs dehumidification.

- Discuss psychrometric charts to explain dehumidification function.

- Discuss the various types available presently and prices associated with purchase and installation of same.

TOPIC OUTLINE

DAY 20 (PM) SOLAR SYSTEMS

TOPIC SPEAKER

A. Dawe SNL

RATIONALE

Solar heating, contrary to popular belief, is an age old technology which still today has many proven economic appliations worthy of consideration for energy retrofit. The trainees should be familiar with the technology and the many potential economic benefits from the sun.

ELABORATION

Upon completion, the trainee will be able to discuss, in general terms, the following:

- the operation of active and passive solar systems;
- the construction, location and orientation of solar collectors and equipment;
- solar domestic hot water systems;
- the economics of solar systems.

METHODOLOGY

- Give brief history of solar use throughout the ages.

- Explain present day difference between active and passive solar use.

- List present day uses of solar collector systems:

  - domestic hot water preheat;
  - possible solar assisted heat pump;
  - space heating.

- Show diagrams and sketches giving typical locations and orientation of solar collectors:

  - explain azimuth;
  - explain tilt;
  - differ between rooftop and gravity feed installations;
  - review solar radiation principles.

- Show diagrams, sketches of collectors and collection systems:

  - closed loop type - explain operation;
  - sizing collectors and system (pumps, etc.) to intended application and use;
  - explain stagnation temperature;
  - carrying system fluid or gas;
  - drain back type - explain operation;
  - air to water collection;
  - air to air collection.

- Review installed costs and potential savings associated with the various types of systems available and their common applications.

TOPIC OUTLINE

DAY 21 (AM)	WOOD HEAT AND WOOD MANAGEMENT	TOPIC SPEAKERS
		D. Sharpe CTT G. Styles IEA

RATIONALE

Wood heating is a very popular alternative to oil and electric space heating in Newfoundland. The trainee should be familiar with this technology to be able to answer questions from home-owners who are considering conversion to wood heating.

ELABORATION

Upon completion, the trainee will be able to:

- differentiate between different types of wood burning space heaters or furnaces;
- describe the proper installation of wood burning equipment with special emphasis on fire safety;
- locate standards for chimneys and or related equipment and components;
- discuss the operation and maintenance of wood burning equipment;
- locate heating values of woods;
- describe method for obtaining timber cutting permits in Newfoundland and Labrador.

METHODOLOGY

D. Sharpe

- Present an overview of forest land ownership and management in the province:
  - 60% owned and/or controlled by major private companies.
- Discuss present situation in Newfoundland forests overall - shortage or surplus?

G. Styles

- Give students basic understanding of combustion process:
- Review history of wood-using appliances to present day uses:
  - Older Types
    - "open" fireplace
    - "Franklin" stove
    - "box-type" stove
    - European "tile" stove
  - More Recent
    - cross draft wood heating
    - improved S-draft stove
    - true down drafted stove
    - down drafted
- Explain improvements that were made on the older type stoves, such as baffling, air tightness, and secondary combustion.
- Discuss storage possibilities for home use of wood and advantages of each method.
- Give relative efficiencies of various types of wood stove and fireplaces.
- Briefly discuss present day methods of measuring efficiencies in wood burners and the many drawbacks associated with it.
- List drawbacks and advantages associated with modern efficient, air tight stoves.
- Review codes, etc. pertaining to wood heating (solid fuel) appliances.
- Review chimney types, their installation, and dual purpose.
- Give handout to students covering economics of wood heating for typical urban dweller purchasing supply of wood, giving costs of wood, stove, chimney, installation and payback figures using comparison with different types of wood.

TOPIC OUTLINE

DAY 21 (PM) GENERAL DISCUSSION SESSION

TOPIC SPEAKERS

A. Dawe	SNL
P. Gamble	HC
D. Stewart	SNL
M. Warren	SNL

RATIONALE

Trainees should be given the opportunity to ask questions on material previously covered. Depending on the topic, the trainees are sometimes not allowed enough time to ask questions in the alloted lecture time.

ELABORATION

Upon completion, trainees should have been given the opportunity to ask questions and receive answers pertaining to previously covered course material.

METHODOLOGY

TOPIC OUTLINE

DAY 21 (PM) COMMUNICATIONS - SESSION 4 TOPIC SPEAKER

E. Reynolds CTT

RATIONALE

To provide a final review of major principles of communications prior to final evaluation audits.

ELABORATION

Upon completion, the trainee will be able to:-

- Understand his/her role as an effective communicator in the conduct of a successful home energy survey.

METHODOLOGY

- Trainees review all topics previously covered in communications classes to see if any outstanding problem areas exist.
- Review principles of communications and good listening.
- Review proper dress suggestions for auditors.
- Review previous role playing activities and suggest improvements in delivery, etc. where necessary.
- Conduct role playing activities for full home audit using audio visual equipment - to help ease any stiffness of delivery or uneasiness of students in audit procedures.

TOPIC OUTLINE

DAY 22 (AM & PM) HOME AUDIT
(Full Student Lead)

TOPIC SPEAKERS

A. Dawe	SNL
D. Stewart	SNL
M. Warren	SNL
P. Hearn	SNL

RATIONALE

Having observed their partner, develop their delivery skills in an "live homeowner" situation the group of trainees must be given the opportunity to practice the delivery of a survey in realistic situation under the observation of supervisory personnel.

ELABORATION

Upon completion, the trainee will be able to:

- deliver a complete audit to a homeowner including:
    - initial introduction and explanation of the project;
    - collection of pertinent data from the home;
    - completion of the data sheet;
    - data entry into the computer;
    - completion of all required forms;
    - explanation of recommendations to the homeowner.

METHODOLOGY

- Arrange for homeowner occupied houses for full scale audit.
- Have four groups of supervisor, student observer and trainee advisor conduct full scale audits.
- Ensure that the trainee advisors know that they are in charge of the survey and not the supervisor. Supervisor will only comment if a major problem cannot be resolved.
- Observe advisors methods and interaction with the homeowner. Record any points for further discussion.
- Repeat process in the afternoon following the formation of new groups.

TOPIC OUTLINE

DAY 23 (AM & PM)

COURSE REVIEW

TOPIC SPEAKERS

A. Dawe	SNL
D. Stewart	SNL
M. Warren	SNL
P. Gamble	HC

RATIONALE

The trainees should be given the opportunity to review the course to make sure they have full and complete set of documentation for all topics covered before the course ends.

ELABORATION

Upon completion, the trainee will:

- have had an opportunity to ask questions on any of the topics covered in the course;
- have received answers to any questions asked during the course;
- have been given copies of any handout material which may have been missed.

METHODOLOGY

- Trainees were advised early in the course to make notes on any outstanding questions on any topics covered. These are now reviewed in detail to ensure all information has been given and accurately received.

- Any handout literature given to trainees throughout the course that there were insufficient supplies of, were obtained and given to students requiring same.

- Discussion was held as to trainees opinions of the way the course was conducted vs. other possible methods, topics covered and speakers' deliveries. Other matters pertaining to overall quality of instructional material used, etc. were also reviewed.

- Trainees were requested to submit written submissions on their evaluations of the course.

TOPIC OUTLINE

DAY 24 (AM)

OPERATING COSTS AND PAYBACK

TOPIC SPEAKERS

A. Dawe	SNL
D. Stewart	SNL

RATIONALE

It will be important for the energy advisor to be able to estimate operating costs before and after energy retrofit. This information, used in conjunction with an estimate of saving will enable the advisor to establish the relative economics associated with carrying out an energy retrofit.

ELABORATION

Upon completion, the trainee, using the computer, will be able to:

- estimate the operating cost of an existing system;
- identify applicable energy retrofits and their resultant saving;
- establish the cost of carrying out a retrofit;
- determine the resultant payback and make recommendations for the implementation of retrofits with "attractive" paybacks.

METHODOLOGY

- Review all surveys that have been conducted to ensure that all procedures, including auditor and computer - related ones, are clearly understood, before evaluation surveys are conducted.

  This includes:

  - considering present situation, including house size, living habits, size and type of heating system auditor can estimate present energy use and cost;
  - considering conditions present, auditor will immediately recognize applicable areas for retrofit improvements;
  - using all data collected and entered into computer, auditor will disseminate information on costs associated with possible retrofit measures;
  - drawing on information attained throughout course, data collected on site and computer read out - auditor will suggest recommended, retrofit measures and will advise of resultant paybacks and savings.

TOPIC OUTLINE

DAY 24 (PM)

GOVERNMENT ASSISTANCE PROGRAMS (Review and Question)

TOPIC SPEAKER

G. Hanrahan EMR

RATIONALE

Having been given a brief overview of the various government assistance programs available for energy retrofit, the trainees should be given an opportunity to ask any questions relating to the programs which may have developed through the course.

ELABORATION

Upon completion, the trainee will be able to:

- answer most questions relating to government assistance programs for energy retrofit, in particular:
  - eligibility clauses;
  - procedures for applying for grants;
  - amounts of funding available.

METHODOLOGY

- Review EMR assistance grants.
- Discuss any questions that have arisen out of course work done in the classroom or in survey conducted with homeowners.
- Distribute handouts in detail on eligible items under the EMR grants.
- Describe the dollar amounts available to homeowners under each program and possible ways to combine both.
- Discuss changes in programs that have taken place since the program start.
- Review procedures to follow for homeowner payment, including:
    - payment of grants tied to property;
    - onus on present resident to ensure no prior grant received before making application;
    - co-payee option;
    - suggestions re. estimates, contracts, invoices, etc.

TOPIC OUTLINE

DAY 25 (AM)

HOME AUDIT
(Full Student Lead)

TOPIC SPEAKERS

A. Dawe	SNL
D. Stewart	SNL
M. Warren	SNL
P. Hearn	SNL

RATIONALE

Having observed their partner, develop their delivery skills in an 'live homeowner' situation the trainees must be given the opportunity as much as possible in the time available to practice the delivery of a survey in realistic situation under the observation of supervisory personnel.

ELABORATION

Upon completion, the trainee will be able to:

- deliver a complete audit to a homeowner including:
    - initial introduction and explanation of the project;
    - collection of pertinent data from the home;
    - completion of the data sheet;
    - data entry into the computer;
    - completion of all required forms;
    - explanation of recommendations to the homeowner.

METHODOLOGY

- Arrange for homeowner occupied houses for full scale audit.
- Have four groups of supervisor, student observer and trainee advisor conduct full scale audits.
- Ensure that the trainee advisors know that they are in charge of the survey and not the supervisor. Supervisor will only comment if a major problem cannot be resolved.
- Observe advisors methods and interaction with the homeowner. Record any points for further discussion.

TOPIC OUTLINE

DAY 25 (PM) AUDIT DEBRIEFING

TOPIC SPEAKERS

A. Dawe	SNL
D. Stewart	SNL
M. Warren	SNL
P. Hearn	SNL
R. Lewis	SNL

RATIONALE

Immediately after the practice surveys, the trainee should be given the opportunity to discuss in detail their work and to receive constructive criticism on techniques and methods employed in collecting, analyzing and relaying information.

ELABORATION

Upon completion, the trainee will have been given an analysis of his/her performance during the survey. The supervisor will have noted both weak and strong points in the students delivery and have made suggestions on ways to improve techniques and methods for collecting and analyzing data.

METHODOLOGY

- Debriefing session is held with all participants of morning audits.
- Allow self-analysis by the trainee advisor. Points raised will be discussed and questions answered.
- Student observers make criticism/comments of a constructive nature from their notes about the morning's audits.
- Supervisors then elaborate on earlier points that were raised and makes suggestions to/criticisms of the audit procedure, as it was conducted.

Appendix VII-B

Advisor's Course Assessments

RESIDENTIAL ENERGY ADVISOR
TRAINING COURSE EVALUATION REPORT

PREPARED BY: Marguerite Moores-O'Donnell
DATE: November, 1982

SUBMITTED TO: ShawMont Newfoundland Limited

RESIDENTIAL ENERGY ADVISOR TRAINING COURSE

EVALUATION REPORT

The following is my report on the recent Energy Advisors Course which was held at the College of Trades and Technology. I would like to thank ShawMont Newfoundland Limited for a well run and organized program. I benefited greatly and learned a lot about energy conservation.

For future energy advisors or courses, I would like to see the following points improved upon:

1. Course Length - I would like to see the course lengthened to a possible six to nine months, to enable the students to learn and digest all the necessary reference material.

2. Guest Speakers - I would like to see the number of speakers limited, thus giving the more important and directly related speakers more time. I would like to see brief outlines or reference material in advance on each speaker's topic. I feel this will enable the students to brief themselves and obtain maximum benefits from each lecture.

3. Classroom Routine - I would like to have seen more workshop routine - Example: Demonstrations on the proper ways of insulating, weather-stripping, caulking and sealing, etc. I feel the advisors, with this knowledge, would be able to detect improper installations and also assist the homeowners on proper installation to help conserve energy.

4. Computer - With reference to the computer, its purpose and use, I feel an introductory program essential. I feel instant computerized results to be more harmful than useful, due to the possibility of input error, thus receiving an inaccurate printout. I feel the data should be obtained at the home, entered in the computer at a later time, the findings reviewed and discussed and then presented to the homeowner with our recommendations.

The way in which the surveys were conducted with two advisors and a supervisor, presented an excellent chance to see my colleagues in action and to be able to ovserve others methods.

Overall, I think the course went very well and I feel it would be a great benefit to the public and government in conserving energy.

RESIDENTIAL ENERGY ADVISOR
TRAINING COURSE EVALUATION REPORT

PREPARED BY: Gerard O'Brien

DATE: November, 1982

SUBMITTED TO: ShawMont Newfoundland Limited

RESIDENTIAL ENERGY ADVISOR TRAINING COURSE

EVALUATION REPORT

"The Newfoundland pilot project is designed to directly assist homeowners to obtain the best advice on energy improvement measures."(1)

"The overall objective of the project," said Mr. Lalonde, "is to motivate homeowners to take action and to make the most effective use of federal programs such as COSP and CHIP."(2)

The success of the Residential Energy Advisory Program depends on a number of considerations:

1) Were the course objectives met and developed;

2) Was the material relevant to the program objectives;

3) Was the Residential Advisory Course defined properly.

The "Course" was developed to satisfy the objectives of Energy, Mines and Resources. The Audit and Advisory Services left both the homeowners and Energy, Mines and Resources with answers of what was needed in Newfoundland and the problems involved. The homeowner was left with an understanding of the importance of conservation of oil and means to help in conservation which would benefit that homeowner. The course was to produce eight people with a knowledge and material to assist the homeowner and offer suggestions pertaining to oil conservation.

The course material was relevant and informative. Without a doubt the material produced was an update and current account of procedures used and ideas developed in the energy field. Procedures and ideas which can be expanded as the energy field expands. The only problem with course material was it was a "Reader's Digest" version. The course should be lengthened so that the full scope of the knowledge can be embedded in the participants. The more the material can be obsorbed the better informed the homeowner will be. (Main Objective)

The program also developed a definition of what a Residential Energy Advisory is and the material needed to offer an Advisory Service in Newfoundland.

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(1) Energy, Mines and Resources
Communique
82/141
August 23/81

(2) Energy, Mines and Resources
Communique
82/141
August 23/81

As the program moves from the classroom to the Residential Sector or aspect of the project, I believe we will understand the extreme need for such a service in Newfoundland and Canada.

It is important to have a Pilot Project; this leaves room for improvements to be incorporated into the program. Improvements which will be readily recognized as the Pilot Project closes.

RESIDENTIAL ENERGY ADVISOR
TRAINING COURSE EVALUATION REPORT

PREPARED BY: Tracey Cook

DATE: November, 1982

SUBMITTED TO: ShawMont Newfoundland Limited

RESIDENTIAL ENERGY ADVISOR TRAINING COURSE

EVALUATION REPORT

Overall, I found the course very interesting and learned a lot during the six week period. It was something that I was interested in prior to continue to pursue it as a carreer.

One aspect that I feel was very important to the success of the course ws the informal relationship between the ShawMont engineers and the advisors. It made everyone more relaxed and personally, I felt that I was encouraged to ask questions whenever I needed information.

In the same way, I felt it was very beneficial to have Peter Gamble available to us all the time. Peter was extremely knowledgeable in all of the topics and it was really good to have him fill in points that speakers may have missed. Again, the informal relationship between Peter and the advisors made us feel free to ask questions.

I think the advisors worked well together as well. Many times, questions one of us had could be answered by another advisor. This was probably due to the varying backgrounds of the advisors and helped to create a good atmosphere.

I don't believe there were any weaknesses in the program that could not be easily remedied in subsequent courses. For example, during the empty house surveys, more emphasis should have been placed on following a certain routine or procedure. As it was, we all went our own ways, and so, when we got to the actual surveys, we were confused as to where to begin. Even the initial overview (explanation) of the program could have been "rehearsed" during these surveys and the observers could have told us if they thought we should add or leave out certain points. Then when we got to the actual surveys, we would have been more confident in what we were telling the homeowners.

Generally, the topics were well covered and the speakers were definitely knowledgeable in their subjects. While reading the report from the PEI Pilot, I noticed "assessment" sheets which listed things that the advisor should know after the various topics. It would have been helpful it we had had a similar sheet prior to the speaker's presentations. In that way, we would have had some idea of questions to ask if we felt the speaker had not adequately covered the topic. It would have been especially helpful at the beginning of the course when we really didn't know enough to be able to ask the questions we should have.

One weakness was the order in which some of the topics were covered. For example, I think it would have been helpful to have discussed in more detail the data form and corresponding computer "quirks" earlier in the program. I think a lot of us experienced frustration in entering some of the data, just because we weren't aware we had to manipulate the data. What we thought was straightforward on the forms, turned out to be not quite that way and it would have prevented a lot of the problems had we been made aware of the "quirks" earlier in the course.

Homeowners' questions have made me feel that I would have liked more detail on exactly what was included in some of the recommendations. For example, furnace tuning vs. furnace servicing. I know the basic difference but more detail would definitely be beneficial when explaining the difference to homeowners.

One topic that wasn't really covered was insulation - the various types and their corresponding RSI (R) values. Again, questions from homeowners have made me feel that it would have been helpful to have spent at least a couple of hours on the topic.

As I mentioned earlier, the speakers were generally very good. Some of them stand out for various reasons.

Elizabeth Reynolds

- Ms. Reynolds should have been given more detail about survey procedure before giving us instruction. It would have been good if she had an actual survey done on her house so that she would have been aware of what we would be doing. As it was, she initially thought the homeowner would have no advance notice of our visit at all. In fact, she thought the advisors would be picking the houses at random. However, once we told her the procedure, she adapted very quickly and gave us very realistic role playing situations.

Lloyd Warren

- Unfortunately, Mr. Warren did not seem to know exactly what information he was expected to give us. He obviously knew his topic but his presentation was lacking. I think he didn't want to get too technical and as a result, left us with very little actual information. In this case, the "assessment" sheet would have been especially valuable.

Rex Cotter

- Mr. Cotter was an excellent speaker. His teaching experience was evident and he gave us the information we wanted in a clear and concise manner without getting too technical.

Bob Platts

- I'm quite sure that Mr. Platts had some very valuable information to give us. However, his comments of the morning gave us a very bad impression of him and we were not as receptive to him as we should have been.

RESIDENTIAL ENERGY ADVISOR
TRAINING COURSE EVALUATION REPORT

PREPARED BY: David Weatherby

DATE: November, 1982

SUBMITTED TO: ShawMont Newfoundland Limited

RESIDENTIAL ENERGY ADVISOR TRAINING COURSE

EVALUATION REPORT

I feel a good way to offer the course is by one or two lecturers that spend time in a lab situation also. Build the students up with a base knowledge and then bring in an expert on the subject to give a lecture. The students would have a basis on which to participate in the question period.

In the previous course, too much time was spent on basic material in the moisture problem area. More time should be devoted to advancing the students ability to find the source and solve it.

The CGSB was a question of the course, I strongly feel that the students should be qualified to these standards. The students of the previous course feel that they could write the exam and pass. But the truth is, that if 8 wrote it the average mark would be very low (approximately 20%). We never touched the basics of this manual.

Solar was not worked on enough. The different types of gain systems ie. window boxes. I agree conserving comes first, but wood is solar, and a step behind direct gain. St. John's may not have as much sun as other places, but it is not as cold either. Should study why, and how to, and not to use solar, such as the fadding of interior decor, and how to handle these problems.

The course where applies should be worked into the schools of building trades, especially carpentry, plumbing and heating (also electricity).

Critizing the individual speakers, I do not feel that I can add any more than the others have said, however, I enjoyed most of them. I think though, if the speakers were more involved with what the course was about, then they could make a more appropriate delivery.

We were continuously told, do not use the stove and other cooking elements to heat the home. Why not use this free heat, you pay for the same electricity, but gain a good home cooked meal. I find in my place, with the heat off all day, is very cold. When I start supper the place warms up considerably. Also, why not light up the house and gain the heat by-product, instead of living in a dark, baseboard radiated room.

This is the opposite for summer, where air conditioners are used, lighting adds to the problem.

Electricity in general was not discussed enough. We went through other heating systems, but never touched the pros and cons of electric. How a house is wired should also be learned.

The advantage of fluorescent lighting especially in summer.

Some things were missed, some well explained. Bob Platts explained the problems in the home quite well, but I still feel, because engineers have a monoply over technical areas, that it wouldn't hurt to explain some basic building physics to the students. Instead of just talking about consequences.

Overall I learned a good deal more than I thought I had. It was a good time for all.

RESIDENTIAL ENERGY ADVISOR
TRAINING COURSE EVALUATION REPORT

PREPARED BY: Fred Doyle

DATE: November, 1982

SUBMITTED TO: ShawMont Newfoundland Limited

RESIDENTIAL ENERGY ADVISOR TRAINING COURSE

EVALUATION REPORT

The energy advisors course, to me, was very informative. In the six weeks that I was here, I learned a great deal about the conservation of energy. This information, I believe, will be very helpful later on in my life.

It seems that the job, which would be related to the course, would be very interesting. However, if I did pursue a career in this field, I would like to play a more active role in the development of the program.

The course, basically, was well presented. With a few exceptions, I believe that the course was put off in a very professional fashion. Between the ShawMont engineers and Peter Gamble, we were kept well informed on everything that was going on.

The ShawMont people gave us information based on their individual expertise. This information was presented well and we were given ample time to ask questions.

Probably the most important part of the program was one Mr. Peter Gamble. Peter was highly informed on most of the topics that were discussed during our classroom sessions. If a speaker left out an important piece of information, Peter would pick up on it and explain it to us, after the speaker left. Without Peter, I believe the course would not have been as successful as it was.

In regards to the speakers, most of them were very good, except for a few. I will go from the 2 worst to the 3 best.

Lloyd Warren: He was knowledgable in his field but was too concerned with relating things on a simple level. This resulted in the advisors not getting the information they wanted. I believe that you should get another, more experience in education, person to do the furnace part of the course.

Bob Platts: Need I say anymore. His name says it all. He was person full of information but his display of ignorance in the morning made us less receptive to his presentation in the afternoon.

Liz Reynolds: Liz was an excellent speaker. Because of the time we spent with her we got to know her on a personal level. Despite the fact she was not informed on exactly what we do during an audit, she adapted well and provided us with a lot of helpful information.

Rex Cotter: Rex was an expert in his field. He knew what we needed to understand about furnaces and gave us the basic, but precise information. Rex was an excellent speaker.

Peter Gamble: As I stated Peter was an excellent speaker. I explained everything I could about Peter earlier on in the report. I believe you should have Peter for any other type of project on this subject.

Some problems with the program were:

1) should have been more informed, earlier, on how to manipulate data so the computer will accept it;

2) should have had more surveys on homes;

3) should have more hands on displays to help aid speakers; (For example: Rex Cotters displays)

4) should give more information to the speakers (ie. Liz Reynolds) on what we actually do during home surveys;

5) you should try to screen the homes done during the training stage (ie. having people who are knowledgable about their home, present while the survey is being done).

I believe all of the course was carried out very well. With exception of the above problems, I feel the program coud not be greatly improved. I really enjoyed the course and I am seriously pursuing a career in this field.

RESIDENTIAL ENERGY ADVISOR
TRAINING COURSE EVALUATION REPORT

PREPARED BY: Richard Mackey
DATE: November, 1982

SUBMITTED TO: ShawMont Newfoundland Limited

RESIDENTIAL ENERGY ADVISOR TRAINING COURSE

EVALUATION REPORT

This is my evaluation of the "Residential Energy Advisor Training Course". I must say that it was an enjoyable experience. It was helpful in all ways to prepare the trainees for their future endeavors, whatever they may be. I do think, however, that some constructive changes could be made in that the right subjects were selected for this course but the depth necessary just was not there. In the following text, I will explain this statement and try to give useful criticism on this course.

EXAM FOR THEORY

For a start I think there should have been an exam for the theory part of the course. Most of our time in class was devoted to the understanding of the theory, but when it came to testing, our whole exam was in the practical aspect. I do understand that the understanding of principals would have come from the CGSB book and that this testing was planned. I would just like to point out that the exam does not have to be a CGSB exam. I think the coordinator, Peter Gamble, could well have decided the areas on which we should have been tested. This way the exam could have been more closely related to the course and it would almost force the students to study their material. This would have eliminated a lot of time necessary to answer in class questions that were already addressed in the CGSB manual.

CGSB MANUAL

I have already referred to the CGSB. I think that this is invaluable to this type of course. A regular routine of referring to the manual should have been established so that the students do realize that it is a good source book. Most of the things mentioned in the CGSB book are directly related to the course. If a steady course is presented from this book, a lot of theory such as heat loss calculations would be covered. Things that would be invaluable to the understanding of the course.

GOVERNMENT PROGRAMS

I think that material on these programs should be forwarded before the government officials come in. This would at least enable the students to become familiar with the programs before hand. By doing this so much time at the beginning of the presentation could be eliminated and devoted to student questions.

CONSTRUCTION TECHNIQUES

The time given to the drafting instructor should have been increased. We have to have a basic understanding of house construction in order to understand where and how to insulate. Two books that I think would have been invaluable during this section of the course are distributed by CMHC. They are "A Glossary of House Building Terms" and "Canadian Wood Frame Construction". These would help eliminate such questions as "What is a knee wall?" and "How do I know its a sloped attic?".

ELECTRICAL

The time devoted to electrical was well chosen. The only way I think to improve this part of the course would be to predate Newfoundland Light and Power and Newfoundland and Labrador Hydro by Peter Gamble's class on Electrical Wiring and Applicances. Then a lot of questions that arose on "Energuide" would have been answered by the professionals. Also the materials presented by these two groups should have been forwarded.

MISCELLANEOUS

The morning audit and afternoon debriefing should have been better coordinated. Personally, I found it difficult to remember what happened the previous week when it came time for the debriefing.

I also think that more time should have been devoted to alternative energy. There is going to be a growing demand for this type of information in the future. People's interest in this type of information is growing daily and we will be the only people that a homeowner will be able to talk to, even if it is only a pamphlet to handout.

RESIDENTIAL ENERGY ADVISOR TRAINING COURSE EVALUATION REPORT

PREPARED BY: Deborah Squires

DATE: November, 1982

SUBMITTED TO: ShawMont Newfoundland Limited

RESIDENTIAL ENERGY ADVISOR TRAINING COURSE

EVALUATION REPORT

These suggestions are not in order of priority, merely in the order that they occured to me. I sincerely hope that they will prove to be of some value in planning future Residential Energy Advisor courses. The suggestions are:

1) The course be extended, possibly to three months. This would help prevent information "overload". It would also provide students with more time for classroom review and trouble shooting, workshop time and on the job type of training.

2) Lecturers and specialists should be limited to two or three guest speakers a week. One main instructor should coordinate and monitor lecture material, and, if necessary, provide basic instruction in each subject BEFORE the specialist speaks. Students would then be able to better assimilate the guest speaker's information, with the end result being more pertinent questioning at the end of the lecture.

3) Homework assignments should be given so that the instructors may evaluate which students will need assistance in specific areas. Students should be familiar with manual heat loss calculations, as one example. A possible assignment for students would be heat loss calculations on a home as specified by the instructor. Results would then be discussed and evaluated by the class with the instructor's supervision.

4) The main tool of the Residential Energy Advisor graduates will be the computer and related software. Unfortunately, this was one of the areas which received the least emphasis with no formal instruction whatsoever. Students should be totally familiar with the program, its flaws and benefits. Basic principles of touch typing and adding machine operation should be incorporated into instruction on the use of the keyboard. General maintenance advice on the care and protection of computer and discs should be covered. Troubleshooting procedures are, in my opinion, a definite must! Practice time on regular typewriters and adding machines would help.

5) Workshop facilities should be set up to expose students to actual conditions, ie: furnace efficiency, caulking and weatherstripping methods, anomalies in construction techniques and insulation techniques and materials.

6) Group discussion and evaluation by the students should be held about midway through the course in order to determine specific needs of that particular class. Weak areas could then be pinpointed and corrected before the course terminated.

7) CGSB qualified instruction and opportunity to do the inspectors' exam should be planned towards the end of the course.

8) Some principles of industrial auditing should be covered.

9) Experienced graduates of the Residential Energy Advisor course should be part of the planning and execution of future courses.

GENERAL COMMENTS AND OBSERVATIONS

Instructors that I would like to see return for future courses are:

Peter Gamble
Rex Cotter
Liz Reynolds
Mr. Hiscock
Mr. Moodey
Jo Heringa.

Guest speakers should include insulation contractors, general contractors, EMR representatives, a lawyer (to advise on liabilities and advisor and client rights), someone from the fire commissioner's office on APPLIED material concerning woodstoves, furnaces, fireplaces, etc.

I would have like more information on passive solar applications for this area. I would have liked more emphasis to be placed on alternatives such as heat pumps and heat exchangers, alone and assisted by solar, or autonomous housing. I wanted to know more about various heating systems and common problems that occur with each.

RESIDENTIAL ENERGY ADVISOR
TRAINING COURSE EVALUATION REPORT

PREPARED BY: Bryan Dunne

DATE: November, 1982

SUBMITTED TO: ShawMont Newfoundland Limited

RESIDENTIAL ENERGY ADVISOR TRAINING COURSE

EVALUATION REPORT

To review the entire program in a short period of time is difficult so I will adopt a shorter form of listing positive and negative aspects of the course, etc.

DATE	POSITIVE	DATE	NEGATIVE
10-13	doing a survey near the beginning of the course very good idea - good way to illustrate what will be expected	10-12	Provincial Mines and Energy Department - some speakers were uninterested/uninteresting - too much reading from scripts - presentation was too rushed - no question/answer period
10-14	Hiscock on wall construction and metric conversion; good		
10-14	Moodey on different housing types; good (appeared to not be enough time alloted to cover all his material thoroughly)	10-18	L. Warren - very informed in his area of specialization - furnaces, etc. but very hard to listen to, talk to and take notes from - too much time spent by students dissecting useful information from the irrelevant.
10-18	Gamble very informed person in many areas S.I. good.		- Had good handouts
10-18	good to have info on CGSB (especially at this point as we thought we would be writing CGSB exam) - Goosney not a very good speaker will	10-19	Nfld. Light and Power - good presentation - some parts (film) dated - because they touched on many areas (eg. solar, construction, insulation) perhaps they should speak closer to the end of the course so they not be misconstrued as being experts in all fields by participants.
10-19	Hydro - good to get general overview of power grid, etc. Some info not useful in jobs perhaps, but other was as it turned out. - Bursey good speaker - interesting		

DATE	POSITIVE	DATE	NEGATIVE
10-19	- Communciations - good idea more time may have been good however, time wasted because instructor was not informed about expectations of course/herself/ students	10-19	CMHC - many parts of presentation may not have been useful for course, although I was personally interested. perhaps more time could have been spent on RRAP, CHRP, and CMRP possibly and Home Improvement Loans and handouts given on all.
10-20	Surveys seemed good - excellent way to relate theoretcial learning to real situation would have been better if we had gone back to homeowner situation, as opposed to staying in empty house situation, as we did.	10-22	Moodey didn't get enough time as Cotter went over time. His presentation was repetitious as he or others had already covered it and was of no use to us.
10-21	Gamble's technical info good. - but I felt at least a couple of people were lost more than once. - somehow it should be stated, if this info will be used in future, how info on force, energy, power, etc. will fit into scheme of things in course. - Gamble very knowledgeable in many areas, so he would sometimes stray from topic under discussion but this wasn't necessarily detrimental. - also, his presence throughout most/all of course served as a continuity - someone who could provide unbiased criticism or interpretation of certain speakers and to fill in "dead" time as it arose	10-22	Hiscock - good speaker, but some not so useful info presented. - spent too much time, in relation to his presentation, outlining what his presentation would contain. - spent too much time on different types of sketches/drawings (although it was interesting)
		10-22	Drover - not a very good speaker - some very useful, interesting info provided. - but I feel should have had someone from St. John's Fire Commissioners office and not Prov. Dept. of Justice, who it turns out, have no jurisdiction over residential dwellings of two units or less.

DATE	POSITIVE	DATE	NEGATIVE
10-21	R. Cotter very good on warm air furnaces - not enough time to explain fully, although excellent job was done	10-26	Communications - - good instructor and good class but time was wasted in this class due to both being misformed about course, etc.
10-22	R. Cotter - should have had more time to spend hands-on with burners, retention heads, solenoid valves, etc.	10-27	House surveys good to get acquainted with equipment - but not enough emphasis on the homeowner's part or on following any set procedure or routine or the input form.
10-22	J. Smith - good to have overview of program - chance to ask questions direct to the source.	11-03	Surveys - problems, shortcomings in computer software, surveys, etc. addressed at end of report.
10-25	L. Warren on pressure/temperature valves good - on kerosene heaters good (topical) - on pot-type oil burners (stoves/space heaters) - as far as pot-type stoves go, someone should have addressed doing efficiency testing on these older oil burners.	11-04	J. Heringa - good topic and interesting presentation in that she wanted us to provide constructive criticism of slide show, which it badly needed - but it didn't really happen because of interruptions by Bob Platts.
	Warren's presentation methods leave a lot to be desired - he touches on many more areas than that of his specialization.	11-04	D. Morris, CMHC - very limited usefulness of his presentation - possibly could have been better, considering he is chief inspector at CMHC.
10-26	Gamble - good - covered worksheets on electricity, heat loss calculations, etc.	11-08	Peat - wasn't reviewed or discussed at all - would have been good to discuss to at least enable advisors to have knowledge of advancements to date and info on feasibility etc.
10-28	Hiscock - went over scale in drawings and ventilation - spent too much time on drawings, though (interesting, though)		

DATE	POSITIVE	DATE	NEGATIVE
11-01	P.. Gravelle presented heat loss due to air leakage only - many good points raised - during parts of presentation it was important to keep in mind his biases		
11-02	L. Walker - good and interesting on wood foundations, etc. - relevant as far as sealing and R-value - also covered floor/roof truss construction.		
11-04	B. Platts - v. good presentation on moisture, etc. - many points seemed to challenge accepted concepts of energy conservation, etc.		
11-05	H. Katzin - good to get info on how program evolved. - info on Nfld. housing stock, etc. - from STATSCAN - but he skipped over this too fast for discussion and/or absorption		
11-08	Wind energy - good to get idea of how wind potential relates to energy sources, etc. - especially as project progressed and it appeared that a fair number of homeowners actually addressed this possibility and wanted at least to know its feasibility.		

DATE	POSITIVE	DATE	NEGATIVE
11-08	Heat Pumps/Exchangers and Solar Applications - very interesting and useful in course/ project - a must because homeowner interest is present in many cases but available info is limited.		
11-09	Wood Management, etc. - very topical subject - D. Sharpe presented good personal, informal talk - G. Stiles - very good presentation - lots of info.		
11-12	Gamble - covered only briefly stack controls on furnaces while waiting for us to leave for Ultramar - should be covered more in depth - perhaps with hands on approach.		
11-12	Ultramar with R. Cotter - good to see wood-oil combinations, kerosene heaters, etc.		
11-15	G. Hanrahan - good to have EMR person to return to answer the inevitable questions that arose during course, surveys, etc.		

THE COURSE, IN GENERAL

- it was good to have many speakers
  - to illustrate diversity of topics included under energy conservation
  - to show differing viewpoints on similar topics
  - to illustrate different presentation techniques (or lack of same)
  - and to show that there are no "pat" answers to many questions/problems that have arisen in this field, which is ever changing.

SURVEYS, DEBRIEFINGS, INPUT FORM, RECOMMENDATION SHEET

- should have had more homeowner - situation practice surveys and possibly less empty house ones.

- time spent on debriefings was adequate near the beginning of the course, but at the practice survey stage not nearly enough time was allotted to go over surveys for constructive criticism and in at least one case the ShawMont person was not present at the debriefing.

- there should be a standard uniform/form of dress for advisors (supplied by contractor or contractee).

- throughout the course, it appeared that some advisors would have benefited from a few small, handy tables for the following information:
  - comparative relation between RSI and imperial R Values on common insulation materials
  - relative R values of various insulation materials of same thickness
  - different common thicknesses of various insulation materials and equivalent minimum R Values.

- an equipment checklist, broken down between contents of advisor kit, homeowner file, computer accessories, etc. would be very useful and possibly prevent leaving objects at a house or showing up at a house without certain objects.

SURVEYS, DEBRIEFING, INPUT FORM, RECOMMENDATION SHEET (Cont'd)

- a smoke pencil would be a helpful piece of equipment because many times it seems that technical know-how is not what convinces people of validity of survey or recommendations, etc. but obvious illustrations such as would be possible with this piece of equipment might prove useful.

- Possibly a list of "tips" for advisors to ensure that certain things not on input form are covered during survey might be good to use in a future course (eg. - asking homeowner if there is anything we should look for during survey; or explaining that info required in interview is for previous winter; or ask if homeowner on auto oil fill-up; etc.)

- advisor's input manual has many inaccuracies (eg. - input 14 - meter number used, not property tax number; - input 21 - end row unit of row housing to be counted as semi-detached - etc.)

- many sections of input form not explained early on in the course - especially subsections 1. to 11. on page 3 (main wall, etc.) - as to their use, what exactly they represent, what each assumes, etc.

- input form should have answer range for all questions other than those with 0 for NO and 1 for YES possible answers - not just some.

- the program is limited in many areas - some examples:

  - inputs 37/38 - possibly should not be asked in interview but later answered by advisor

  - inputs 41/42 - answer range not wide enough, not enough flexibility

  - inputs 41-44 - advisors should be made aware of how much hot water each assumes

    primary heating section - what dollar amount to enter for KWH/degree day method - total electrical bill or just space heating portion only

  - inputs 201-268 - answer range not wide enough to allow indication of degree of sealing needed

  - inputs 271-273 - not explained enough how these affect sealing recommendations and possibly answer range not wide enough

  - input 282 - worded poorly in advisor's input manual

  - input 326 - only one space for potential insulation to be entered under any one subsection

    foundation subsection - not enough spaces for height above grade and depth of insulation if more than one entry into subsection 9 and 10.

- recommendation sheet - furnace efficiency is listed on sheet but because it is dependent on many variables perhaps either it shouldn't be given to homeowners or it should be included with smoke number, stack temperature, etc.

- more information should be made available to be given to homeowners on CHIP or COSP programs and on other federal government programs (eg. RRAP)

- as a result of PEI pilot project being conducted a program of continuing or re-education of burner mechanics was instituted to inform them of the purposes of the pilot project and also to standardize knowledge about retrofit measures affecting their trade. This would appear to be a beneficial by-product of the project.

APPENDIX VIII

COMMUNICATIONS SUPPORT

Appendix VIII-A

Letter of Introduction

ShawMont Newfoundland Limited

VIRGINIA PARK PLAZA
NEWFOUNDLAND DRIVE, ST. JOHN'S

Postal Address

P.O. Box 9600
St. John's
Newfoundland
A1A 3C1

Ph. (709) 754-0250
Telex: 016-4122

Dear Homeowner,

This fall, a Home Energy Advisory Service is being offered to a limited number of homeowners in Happy Valley - Goose Bay by Energy Mines and Resources Canada.

The service, managed by ShawMont Newfoundland Limited, involves a comprehensive, on site, energy survey of your home which will recommend cost-effective measures for reducing your energy costs this winter.

There is no charge for this service.

Here is how it works: Our dispatcher will call to arrange a convenient time for a trained energy advisor to visit your home. The visit will begin with a brief interview to determine your fuel consumption and energy usage patterns. Your advisor will then conduct a thorough inspection of all the potential energy loss factors of your home, such as: insulation, the heating system, and air leakage. Using a computer assisted procedure, your advisor will identify opportunities for energy conservation and discuss with you a plan for a more comfortable and more energy efficient home this winter. The advisor will also outline the possibilities of using federal assistance programs to help offset the cost of implementing energy conservation measures.

The entire visit may take between two and three hours depending on the size and age of your home, and the advisor's requirements for completing the evaluation.

We invite you to take advantage of the Home Energy Advisory Service by submitting the attached application before November 7, 1982. A prepaid envelope is supplied for your convenience. Because this service is limited it may be necessary to select applications from a short list arranged by housing types. Successful applicants can expect the advisor's visit to be scheduled within five weeks of our receipt of the application.

enerSave énerSage

Newfoundland & Labrador Home Energy Advisory Pilot Project

Appendix VIII-B

Energy Conservation Products and Services Directory

ENERGY CONSERVATION PRODUCTS AND SERVICES DIRECTORY

Prepared By:

SHAWMONT NEWFOUNDLAND LIMITED
P.O. Box 9600
Virginia Park Plaza
Newfoundland Drive
St. John's, Newfoundland
A1A 3C1

(709) 754-0250

PLEASE READ THIS FIRST

The following businesses have voluntarily responded to our requests for information regarding energy conservation products and services. We will attempt to periodically update this directory and accept no responsibility for omissions.

This directory is intended to be used as a reference by homeowners who have requested the ENERSAVE service. Inclusion in this directory does not constitute a recommendation or endorsement by ShawMont Newfoundland Limited or its staff.

A word about costs:

Your EnerSave advisor may estimate a price for implementing certain energy conservation recommendations to assist you in making investment decisions.

These costs are rough estimates. Changing costs for materials and labour and the exact extent of the work to be done may result in a justifiable variance between the EnerSave advisors estimate and the one you receive from your supplier or contractor. If you have any questions regarding these costs, feel free to call your advisor at 754-0250.

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1. INSULATION

1.1 Insulation Suppliers

Abbott & Haliburton Co., Ltd.	Port au Port AON 1TO	648-2225 648-2235
Atlantic Building Materials	Grand Falls	489-2195
Atlantic Building Materials	Gander A1V 1A2	256-3971
Atlantic Gypsum Limited	St. John's	726-2396
Atlantic Gypsum Limited	Corner Brook A2H 1A3	634-8231
Aylwards Limited	Placentia AOB 2YO	227-2145 227-2146
George R. Batten Ltd.	Bay Roberts AOA 1GO	786-2176 786-3240
Beauchamp Hardware Ltd.	Port aux Basques AOM 1CO	695-2115
Louis Briffett and Sons Ltd.	Glovertown AOG 2LO	533-2816 533-6991
Stan Dawe Ltd.	Corner Brook A2H 6C2	639-9131
Diamonds Building Supplies Ltd.	Stephenville A2N 2Y6	643-5627
Do-Rite Insulation Ltd.	St. John's A1A 2Y6	726-0634
A. Duffitt (1976) Ltd.	Clarenville AOE 1JO	466-7994
Eastern Chemical Ltd.	St. John's A1B 3M9	364-7758 364-7759
Fogo Island Building Supplies & Hardware	Fogo AOG 2BO	266-2460
Guildfords Limited	St. John's A1B 3N9	368-3114
Hickman's Building Supplies	St. John's A1B 4B5	579-5187
Hickman's Building Supplies	Grand Falls A2A 2K2	489-2111
Ray Hindy Ltd.	Winterton AOB 3MO	583-2241
Island Wide Insulation Ltd.	New Harbour T.B. AOB 2PO	582-2719
Koma Home Insulation Ltd.	Goulds AOA 2KO	364-9579
Letto's Sales Ltd.	L'Anse au Clair AOK 3KO	931-2680
Lumber Mart	Labrador City A2V 2K3	944-2653
Mahoneys Plumbing & Heating Ltd.	Harbour Breton AOH 1PO	885-2821 885-2819
Major Building Supplies Ltd.	Pasadena AOL 1KO	686-2007
J. I. Pritchett and Sons Ltd.	Gambo AOG 1TO	674-4686
Seal & Save Insulation Ltd.	St. Phillips AOA 3KO	895-2074
Snelgrove Supermarket Ltd.	Happy Valley/ Goose Bay AOP 1SO	896-2411
Spracklins Building Supplies	Gander A1V 1W4	651-3464
Tourout Enterprises Ltd.	Port au Port AON 1TO	642-5976
Ultramar Canada Inc.	St. John's A1B 1R6	726-9662
D. J. Williams & Sons Ltd.	Roberts Arm AOJ 1RO	652-3333
Wiseman's Building Supplies	Trinity B.B. AOG 4LO	678-2526

1.2 Insulation Contractors

Do-Rite Insulation Ltd.	St. John's	A1A 2Y6	726-0634
Home Insulation (Atlantic) Ltd.	St. John's	A1E 2Z6	726-8731
K & P Contracting Ltd.	Torbay	A0A 3Z0	437-6935
Labrador Roofing and Insulation Company	Wabush	A0R 1B0	282-5606
Lewis Insulation Co.	St. John's		368-8802
J. I. Pritchett & Sons Ltd.	Gambo	A0G 1T0	674-4686
Seal & Save Insulation Ltd.	St. Phillips	A0A 3K0	895-2074
Ultramar Canada Inc.	St. John's	A1B 1R6	726-9662
Guildfords Ltd.	St. John's	A1B 3B9	368-3114
Island Wide Insulation Ltd.	New Harbour T.B.	A0B 2P0	582-2719
Koma Home Insulation Ltd.	Goulds	A0A 2K0	364-9579
Lewis Insulation Co.	Carbonear	A0A 1T0	596-7598
Nuvcan Supply Ltd.	Springdale	A0J 1T0	673-3663
A. St. George & Sons Ltd.	Heart's Desire	A0A 2B0	588-2300
Tourout Enterprises Ltd.	Port au Port	A0N 1T0	642-5976
Wiseman's Building Supplies	Trinity B.B.	A0G 4L0	678-2526

2. SEALING

2.1 Weatherstripping Suppliers

Atlantic Building Materials	Gander	A1V 1A2	256-3971
George R. Batten Ltd.	Bay Roberts	AOA 1GO	786-2176 786-3240
Stan Dawe Ltd.	Corner Brook	A2H 6C2	639-9131
A. Duffitt (1976) Ltd.	Clarenville	AOE 1JO	466-7994
Fogo Island Building Supplies and Hardware	Fogo	AOG 2BO	266-2460
Island Wide Insulation Ltd.	New Harbour T.B.	AOB 2PO	582-2719
Lumber Mart	Labrador City	A2V 2K3	944-2653
Snelgrove Supermarket Ltd.	Happy Valley/ Goose Bay	AOP 1SO	896-2411
Tourout Enterprises Ltd.	Port au Port	AON 1TO	642-5976
Aylwards Limited	Placentia	AOB 2YO	227-2145 227-2146
Louis Briffett & Sons Ltd.	Glovertown	AOG 2LO	533-2816 533-6991
Diamond's Building Supplies Ltd.	Stephenville	A2N 2Y6	643-5627
EnerTech Ltd.	St. John's	A1B 1W7	722-8554
Ray Hindy Ltd.	Winterton	AOB 3MO	583-2241
Kennedy's Pro Hardware Ltd.	Manuels	AOA 2YO	834-4451 834-4752
Major Building Supplies Ltd.	Pasadena	AOL 1KO	686-2007
Spracklin's Building Supplies	Gander	A1V 1W4	651-3464

2.2 Air Sealing Materials and Contractors

Atlantic Building Materials	Gander	A1V 1A2	256-3971
George R. Batten Ltd.	Bay Roberts	A0A 1G0	786-2176 786-3240
Louis Briffett & Sons Ltd.	Glovertown	A0G 2L0	533-2816 533-6991
Diamond's Building Supplies Ltd.	Stephenville	A2N 2Y6	643-5627
Do-Rite Insulation Ltd.	St. John's	A1A 2Y6	726-0634
Eastern Chemical Ltd.	St. John's	A1B 3M9	364-7758
EnerTech Ltd.	St. John's	A1B 1W7	722-8554
Fogo Island Building Supplies and Hardware	Fogo	A0G 2B0	266-2460
Heat Seal Ltd.	St. John's	A1C 4X9	726-9103
Hickman's Building Supplies	St. John's	A1B 4B5	579-5187
Island Wide Insulation Ltd.	New Harbour T.B.	A0B 2P0	582-2719
K & P Contracting	Torbay	A0A 3Z0	437-6935
Snelgrove's Supermarket Ltd.	Happy Valley/ Goose Bay	A0P 1S0	896-2411
Tourout Enterprises Ltd.	Port au Port	A0N 1T0	642-5976

2.3 Storm Doors and Windows

Atlantic Building Materials Gander A1V 1A2	256-3971
Louis Briffett & Sons Ltd. Glovertown A0G 2L0	533-2816
Hickman's Building Supplies Grand Falls A2A 2K2	489-2111
Humber Aluminum Co., Ltd. Corner Brook A2H 3C2	634-3363 634-4661
Labrador Roofing and Insulation Ltd. Wabush A0R 1B0	282-5606
Lewis Insulation Co. St. John's	368-8802
Osmond Enterprises St. John's A1E 2M3	368-9887
George R. Batten Ltd. Bay Roberts A0A 1G0	786-2176
Diamond's Building Supplies Ltd. Stephenville A2N 2Y6	643-5627
Home Energy Products Ltd. St. John's	579-9566
Island Wide Insulation Ltd. New Harbour T.B. A0B 2P0	582-2719
Lewis Insulation Co. Carbonear A0A 1T0	596-7598
Major Building Supplies Ltd. Pasadena A0L 1K0	686-2007
Snelgrove Supermarket Ltd. Happy Valley/ A0P 1S0 Goose Bay	896-2411

3. HEATING SYSTEM

3.1 Fuel Efficient Furnaces and Heaters

Astor Limited	Catalina	A0C 1J0	469-3436
Ener-Mec Limited	St. John's		722-5656
Kennedy's Pro Hardware	Manuels	A0A 2Y0	834-4451 834-4752
Normore's Heating Service Ltd.	Springdale	A0J 1T0	673-3128
Sun Heating & Air Conditioning Ltd.	Gander	A1V 1A1	256-3488
Ultramar Canada Inc.	St. John's	A1B 1R6	726-9662
Louis Briffett & Sons Ltd.	Glovertown	A0G 2L0	533-2816 533-699
Jim Gannon Furnace Service	Blaketown	A0B 1C0	759-2934
Letto's Sales Ltd.	L'Anse au Clair	A0K 3K0	931-268
Snelgrove's Supermarket Ltd.	Happy Valley/ Goose Bay	A0P 1S0	896-241
Thermec Limited	St. John's	A1E 2Z6	579-992

3.2 Furnace Tuning

Jim Gannon Furnace Service	Blaketown	A0B 1C0	759-2934
Norris Services	Clarenville	A0E 1J0	466-7317
Ultramar Canada Inc.	St. John's	A1B 1R6	726-9662
Normore's Heating Service Ltd.	Springdale	A0J 1T0	673-31
Parsons Heating Suppliers	Happy Valley/ Goose Bay	A0P 1S0	896-364 896-317

3.3 Wood Stoves and Furnaces

Abbott and Haliburton Co., Ltd.	Port au Port	AON 1TO	648-2225 648-2235
Atlantic Building Materials	Grand Falls		489-2195
Beauchamp Hardware Ltd.	Port aux Basques	AOM 1CO	695-2115
Stan Dawe Ltd.	Corner Brook	A2H 6C2	639-9131
D. Duffitt (1976) Ltd.	Clarenville	AOE 1JO	466-7994
Jim Gannon Furnace Service	Blaketown	AOB 1CO	759-2934
Kennedy's Pro Hardware	Manuels	AOA 2YO	834-4451 834-4752
Lumber Mart	Labrador City	A2V 2K3	944-2653
Masonry Supplies Ltd.	St. John's	A1B 3P9	722-6880
Normore's Heating Service Ltd.	Springdale	AOJ 1TO	673-3128
Ornamental Concrete Ltd.	St. John's	A1B 3R2	753-0491
James W. Patey Plumbing & Heating Ltd.	St. Anthony	AOK 4SO	454-8979
J. I. Pritchett & Sons Ltd.	Gambo	AOG 1TO	674-4686
Snelgrove's Supermarket Ltd.	Happy Valley/ Goose Bay	AOP 1SO	896-2411
Tourout Enterprises Ltd.	Port au Port	AON 1TO	642-5976
D. J. Williams & Sons Ltd.	Roberts Arm	AOJ 1RO	652-3333
Atlantic Building Materials	Gander	A1V 1A2	256-3971
Aylwards Limited	Placentia	AOB 2YO	227-2145 227-2146
Louis Briffett & Sons Ltd.	Glovertown	AOG 2LO	533-2816 533-6991
Diamond's Building Supplies Ltd.	Stephenville	A2N 2Y6	643-5627
Fogo Island Building Supplies and Hardware	Fogo	AOG 2BO	266-2460
T. Gillam Ltd.	Corner Brook	A2H 3M1	785-2228
Letto's Sales Ltd.	L'Anse au Clair	AOK 3KO	931-2680
Mahoney's Plumbing & Heating Ltd.	Harbour Breton	AOH 1PO	885-2821 885-2819
Newfoundland Saddlery and Leather Company	St. John's	A1C 1H7	753-3661
Norris Services	Clarenville	AOE 1JO	466-7317
Parsons Heating Supplies	Happy Valley/ Goose Bay	AOP 1SO	896-3646 896-3175
Sam Pike Masonry Ltd.	Blaketown	AOB 1CO	759-2900
Sentek Ltd.	Grand Falls	A2A 2J9	489-2555
Sun Heating and Air Conditioning Ltd.	Gander	A1V 1A1	256-3488
Ultramar Canada Inc.	St. John's	A1B 1R6	726-9662
Yetman's Enterprises	Chamberlains	AOA 2YO	834-8968

3.4 Prefabricated Chimneys

Atlantic Building Materials Gander A1V 1A2	256-3971	Atlantic Building Materials Grand Falls	489-219
Beauchamp Hardware Ltd. Port aux Basques AOM 1CO	695-2115	A. Duffitt (1976) Ltd. Clarenville AOE 1JO	466-7994
Kennedy's Pro Hardware Manuels AOA 2YO	834-4451	Lumber Mart Labrador City A2V 2K3	944-2653
Masonry Supplies Ltd. St. John's A1B 3P9	722-6880	Newfoundland Saddlery and Leather Company St. John's A1C 1H7	753-3661
Normore's Heating Service Ltd. Springdale AOJ 1TO	673-3128	Ornamental Concrete Ltd. St. John's A1B 3R2	753-0491
Parson's Heating Supplies Happy Valley/ AOP 1SO Goose Bay	896-3646	Ultramar Canada Inc. St. John's A1B 1R6	726-9662
Yetman's Enterprises Chamberlains AOA 2YO	834-8968		

3.5 Setback Thermostats

Sentek Limited Grand Falls A2A 2J9	489-2555	Ultramar Canada Inc. St. John's A1B 1R6	726-9662

3.6 Delayed Action Solenoid Valves

Ultramar Canada Inc. 726-9662
St. John's A1B 1R6

3.7 Solar Heating Equipment

Enertec Limited 722-8554
St. John's A1B 1W7

Home Energy Products 579-9566
St. John's

Thermec Limited 579-9926
St. John's A1E 2Z6

3.8 Heat Exchangers

Ener-Mec St. John's	722-5656	Home Energy Products St. John's	579-956
K & P Contracting Torbay AOA 3ZO	437-6935	Thermec Limited St. John's A1E 2Z6	579-9926

3.9 Heat Pumps

Ener-Mec St. John's	722-5656	EnerTech Limited St. John's A1B 1W7	722-85
Home Energy Products Ltd. St. John's	579-9566	Thermec Limited St. John's A1E 2Z6	579-9926

4. DOMESTIC HOT WATER SYSTEMS

4.1 Energy Efficient Water Heaters

Sun Heating and Air Conditioning Limited Gander A1V 1A1	256-3488		

4.2 Flow Restrictions

EnerTech Limited St. John's A1B 1W7	722-8554	Home Energy Products Ltd. St. John's	579-9566

4.3 Hot Water System Insulation

Ray Hindy Limited Winterton A0B 3M0	583-2241	Home Energy Products Ltd. St. John's	579-9566
Sun Heating and Air Conditioning Limited Gander A1V 1A1	256-3488		

5. MISCELLANEOUS ENERGY SAVING EQUIPMENT AND SERVICES

5.1 Window Shades, Shutters and Quilts

Home Energy Products Ltd. St. John's	579-9566

5.2 Vapour Barrier and Ventilation Materials and Equipment

Do-Rite Insulation ltd. St. John's A1A 2Y6	726-0634	Eastern Chemicals Ltd. St. John's A1B 3M9	364-7758 364-775
Home Energy Products Ltd. St. John's	579-9566	Island Wide Insulation Ltd. New Harbour T.B. A0B 2P0	582-271
K & P Contracting Ltd. Torbay A0A 3Z0	437-6935	Lumber Mart Labrador City A2V 2K3	944-265

5.3 Foundations

Wallken Enterprises Ltd. St. John's A1N 2C3	368-7473 368-0138

5.4 Insulated Siding

Humber Aluminum Co., Ltd. Corner Brook A2H 3C2	634-3363 634-4661	Lewis Insulation Co. Carbonear	596-7578
Lewis Insulation Co. St. John's	368-8802		

APPENDIX IX

MAIN PILOT ASSESSMENT SURVEYS

Appendix IX-A

Advisor's Reports

RESIDENTIAL ENERGY ADVISORY SERVICE

ADVISOR'S REPORT FORM

ADVISOR ____________ HOMEOWNER ____________ Date of Audit ________

PRE-AUDIT PREPARATION

	Yes	No	Comments
1. Were directions to the home adequate?	n=80 (95.2)	n=4 (4.8)	
2. Was the homeowner expecting you?	n=83 (100)		
3. Were fuel records sorted and ready?	n=56 (69.1)	n=25 (30.9)	
4. Did the homeowner have a good understanding of what to expect from your visit?	n=77 (91.7)	n=7 (8.3)	
5. Was the decision maker(s) present?	n=71 (84.5)	n=13 (15.5)	

INTERVIEW

	Yes	No	Comments
6. Did the homeowner understand the need for the interview questions?	n=84		
7. Was the homeowner confused by any of the questions?	n=2 (2.4)	n=82 (97.6)	
8. Did you feel that the insulation values of walls and attics provided by the homeowner were accurate?	n=78 (94.0)	n-5 (6.0)	
9. Was the interview impaired by distractions or delays?	n=16 (19.3)	n=67 (80.7)	

MEASUREMENT AND INSPECTION

	Yes	No	Comments
10. Did you have any difficulty calculating the house's perimeter?	n=4 (4.8)	n=80 (95.2)	
11. Were you able to thoroughly inspect the attic, crawl spaces, ur exposed floors?	n=66 (78.6)	n=18 (21.4)	
12. Were you able to measure and evaluate windows or doors?	n=82 (98.8)	n=1 (1.2)	
13. Were you able to source moisture problems?	n=71 (94.7)	n=4 (5.3)	

		Yes	No	Comments
14.	Were you able to perform a furnace efficiency test on the oil burner?	n=66 (88.0)	n=9 (12.0)	
15.	Were you able to identify and assess contributions from other sources of heat?	n=83 (98.8)	n=1 (1.2)	
16.	Did maintenance problems considerably affect the conservation potential of the house?	n=5 (5.0)	n=1 (94.0)	
17.	Did your inspection sequence follow the forms?	n=84 (100.0)		
18.	Were you prevented from completing your inspection by problems with or lack of equipment?	n=3 (3.6)	n=81 (96.4)	
19.	Were you able to record all pertinent house data on the forms?	n=80 (95.2)	n=4 (4.3)	
20.	Did the homeowner follow you for the majority of your inspection?	n=75 (91.5)	n=4 (8.5)	
21.	Did you experience any other problems in performing the inspection and measurement part of the survey?	n=4 (4.8)	n=80 (95.2)	
COMPUTER HARDWARE				
22.	Did the computer accept all the inputs?	n=83 (98.8)	n=1 (1.2)	
23.	Did any computer related problems prevent you from completing the audit?	n=14 (16.9)	n=69 (83.1)	
COMPUTER SOFTWARE				
24.	Did the costs, savings, and priority of recommendations correlate with your intuitive deductions?	n=74 (90.2)	n=8 (9.8)	
25.	Were, in your opinion, any recommendations misplaced, or omitted?	n=12 (14.6)	n=70 (85.4)	
26.	Did the woodheating routine address the homeowner's need for information?	n=21 87.5)	n=3 (12.5)	

	Yes	No	Comments
27. Did you experience any other problems or see opportunities for improving the software?	n=19 (23.8)	n=61 (76.2)	
CONSULTATION			
28. Was the homeowner attentive and receptive when you presented your results?	n=76 (97.4)	n=2 (2.6)	
29. Did the homeowner relate positively to your recommendations?	n=74 (97.4)	n=2 (2.6)	
30. Was information on government programs requested?	n=67 (83.8)	n=13 (16.2)	
31. Was information on contractors requested?	n=31 (38.8)	n=49 (61.2)	

32. What was the time spent in each part of the survey?

Interview 15-55 min. Inspection and Measurement 30-180 min.

Computer inputs & writing recommendations 15-60 min.

Presentation of Results 5-85 min.

33. What was the homeowner doing while you were inputting data into the computer and writing recommendations?

1. Watching or Talking to Advisor	n=24(30.0)	3. Other	n=33 (41.3)
2. Reading Home Info. Kit	n=23(28.75)		

34. Did this survey reveal any requirements for additions to the training program?

1. Furnace Info.	n=2 (2.5)	3. No	n=77 (95.1)
2. Insulation Info.	n=1 (1.2)	4. Yes	n=1 (1.2)

5. What percentage of your recommendations would you estimate this homeowner will adopt?

0-100 35-100

6. Did you need additional support materials to satisfactorily complete this survey?

1. Smoke Pencil	n=15 (19.0)	3. Yes	n=4 (5.1)
2. Samples	n=3 (3.8)	4. No	n=57(72.1)

. When you left, was the homeowner(s):

n=6 (7.7) about the same as when you came

n=1 (1.3) still confused about what to do

n=1 (1.3) more knowledgeable about the house - understands what has to be done - unsure about where to begin?

n=10
(12.8) wants to proceed but feels financially constrained from investing in any measure costing more than $100.

n=60
(76.9) convinced the savings are worth the investment and will take action for this winter.

37. Did the homeowner have any previous experience with audit programs, Enersave, etc.?

n=72 (91.1) No   n=7 (8.9) Yes

If yes, please explain:

____

Appendix IX-B

Homeowner's Questionnaire Response

ANALYSIS OF HOMEOWNER RESPONSE TO AUDITS, NEWFOUNDLAND RESIDENTIAL ENERGY AUDIT PILOT PROJECT

FEBRUARY, 1983

IBI Group
156 Front Street West
6th Floor
Toronto, Canada
M5J 2L6
Cable Address: IBIGRP
(416) 596-1930

March 1, 1983

Mr. Wayne Lewis
Project Manager
ShawMont Newfoundland Ltd.
Virginia Park Plaza
Box 9600
St. John's, Newfoundland
A1A 3C1

Dear Mr. Lewis:

Analysis of Homeowner Response to Audits

Enclosed please find our analysis of homeowners' responses to the pilot project residential energy audits in Newfoundland.

If you have any questions or comments regarding the analysis, please do not hesitate to call.

Yours truly

IBI GROUP

Harold J. Katzin
Director.

HJK:es

IBI is a group of companies practicing professional consulting and is affiliated with Beinnaker/Irwin Associates Architects Engineers

ANALYSIS OF HOMEOWNER RESPONSE TO AUDITS, NEWFOUNDLAND RESIDENTIAL ENERGY AUDIT PILOT PROJECT

The following report summarizes the results of the analysis of questionnaires completed by Newfoundland homeowners following the residential energy audit of their home as part of the Energy, Mines and Resources Canada Pilot Project. The response rate was 51.2% (i.e. 65 questionnaires received) from a total of 127 questionnaires which were sent out.

The questionnaire was left with the homeowner, following the audit. It consisted of a series of multiple choice questions allowing for some comments, which were aimed at determining homeowners' opinions of the usefulness of the audit and of the quality of the advisors' presentation. A copy of the questionnaire with the response and frequencies of answers, can be seen in Appendix A.

OVERALL EVALUATION

The majority of respondents, 58.7%, stated that the visit was informative, but much of the information provided was already known to them. Another 39.7% reported that the visit was extremely useful and provided them with information they would not otherwise have known.

Exhibit 1 shows homeowners' ratings of the energy advisors' work and general approach. Most homeowners (70.3%) rated the energy advisors excellent in terms of being helpful and courteous. Comments were split between good (48.4%) and excellent (40.6%) on how well informed the advisor was on topics the homeowners thought important. The majority of homeowners found the advisor easy to understand (53.1%) and careful in his/her work (59.4%).

Approximately two-thirds of homeowners stated that the survey method was more detailed than they expected and almost all (95.2%) felt that the survey method was thorough enough to accurately assess their house. Most homeowners (78.1%) thought that the total time required for the advisor's visit was adequate to conduct and discuss the survey. Another 12.5% did not think the time was long enough and 7.8% stated that the time required was unnecessarily long.

Of a sample of 60 homeowners, all felt that the advisor's presentation helped to make the information easy to understand. Over 90% of homeowners stated that the advisor's presentation was helpful in showing them a more effective approach to energy conservation.

Almost half the homeowners found the brochure they received before the advisor's visit somewhat helpful and approximately 22% found it very helpful. It should be noted that almost 27% of homeowners reported that they did not receive a pre-audit brochure.

Approximately 89% of homeowners in a group of 61 who responded, stated that the advisor's visit conformed to their expectations based on pre-audit materials received and/or the pre-audit phone call from ShawMont. Of the 11% who stated that the visit did not conform to their expectations, the reasons given were: more testing was expected; it took more time than expected; more informative than expected; use of house plans instead of visual inspection and no attention paid to heat loss from electrical outlets or fireplace.

AVAILABLE INFORMATION

About half the homeowners surveyed, found the brochures and materials in the homeowner information kit somewhat helpful to their understanding of energy conservation, while slightly less found this information very helpful. Almost all of the homeowners stated that the recommendations presented by the advisor, were easy to understand and approximately two-thirds of the homeowners who responded, stated that the recommendations were realistic in estimating savings and practical for their situation. Only two homeowners reported that no recommendations were given.

Of 64 homeowners who responded, approximately 72% stated that the information received on available government grants for energy conservation measures was very helpful in providing them with information on programs and available funds. Almost 20% stated that the information was somewhat helpful but they were unsure whether or not they are eligible.

RESULTS AND RECOMMENDATIONS

Approximately 60% of homeowners in the group of 63 who responded, reported that the advisor found problems that the owner was not previously aware of. Of these problems, furnace efficiency was mentioned in 50% of cases. Other problems which the advisor made the homeowner aware of were, draft or heat loss areas, lack of insulation, excessive hot water temperature, and moisture and ventilation problems.

Of the total number of recommendations received from the survey, 25.4% of homeowners stated they would carry out approximately 51-75% of recommendations, 23.8% would carry out approximately 26-50%, 17.5% would carry out approximately 1-25%, and 12.7% would carry out approximately 76-99%.

Of 62 homeowners, 80.6% feel that their home's energy cost or consumption will decrease this winter as a result of the advisor's visit and their actions. Of these homeowners, 45.1% estimate a 5-10% reduction and 43.1% estimate a 10-25% reduction in energy costs for this year.

Over 90% of homeowners feel that a home energy advisory service of this sort is needed by Newfoundland homeowners. Approximately 83% of surveyed homeowners would recommend the Home Energy Advisory Service to others. Another 12% would recommend the service with some reservations and almost 5% stated they would not recommend the service to others. Some of the reasons given for not recommending the service were: well informed consumers would receive limited value from the service; more accurate equipment is needed to detect heat loss around doors and windows; and inspection may not be complete enough using house plans.

Just over one half of a sample of 62 homeowners would be willing to pay for an energy survey of their home. Of those who stated how much they would be willing to pay most (89.3%) reported $50 or less. The responses ranged from $10.00 to $200.00.

Only one-quarter of 63 homeowners who responded to the pilot project questionnaire have submitted a completed form to the EnerSave program and received an evaluation of their home by that method. Of those that participated in EnerSave, approximately 85% found the information received in it less useful than the pilot audit while approximately 15% found it about the same.

Additional comments were made by approximately 43% of the homeowners who responded. The majority of comments about the service and advisors were positive.

Some of the comments were:

- advisor courteous, helpful and survey was useful;
- already aware of most problems;
- cost vs payback very helpful;
- financial payback/prioritization was not useful;
- advisor was well informed on current technology;
- did not deal with humidity problems that will be found after recommendations are carried out;
- residence already energy-efficient, recommendations were minor eg. flow restrictors;
- the program would be significantly improved if the homeowner was more actively involved;
- analyst should be more aware of how to remedy problems i.e.: construction materials and practices;
- could not save energy or money due to the size of my home and the heating system presently used;

- suggest the use of an infrared camera to take pictures of specific areas of heat loss;
- some quantitative measurement of existing insulation in outside walls of house would be very desirable;
- expecting more in the way of instruments to measure heat loss.

Appendix B contains all comments made on questions 8 and 13.

EXHIBIT 1

HOMEOWNERS' RATING OF ENERGY ADVISORS' WORK

STATEMENT	POOR %	FAIR %	AVERAGE %	GOOD %	EXCELLENT %
Helpful and courteous n=64	--	--	1.6	28.1	70.3
Well informed on topics you thought important? n=64	--	1.6	9.4	48.4	40.6
Easy to understand n=64	--	--	6.2	40.6	53.1
Careful in his/her work n=64	--	1.6	3.1	35.9	59.4

APPENDIX A

QUESTIONNAIRE AND RESPONSE RATE

APPENDIX A

QUESTIONNAIRE AND RESPONSE RATE

The following questionnaire summarizes the response rate on the homeowners' report forms. Total numbers of responses to each question are expressed as n= ___. Percentages of responses are shown in brackets.

NEWFOUNDLAND AND LABRADOR
HOME ENERGY ADVISORY PILOT PROJECT

1. Which one of the following statements best describes your overall feelings about the energy advisor's visit? n=63

The visit was extremely useful and provided me with information I would not otherwise have known.	n=25 (39.7%)
The visit was informative, but much of the information provided was already known to me.	n=37 (58.7%)
The visit was not useful to me and did not tell me anything I didn't already know.	n=1 (1.59%)

2. On a scale of 1 (poor) to 5 (excellent), how would you rate the energy advisor's work and general approach? Please circle the most appropriate number in each category. n=64

Was he/she:		POOR	FAIR	AVERAGE	GOOD	EXCELLENT
	n=			1(1.6%)	18(28.1)	45(70.3)
Helpful and courteous?		1	2	3	4	5
	n=		1(1.6%)	6(9.4%)	31(48.4)	26(40.6)
Well informed on topics you thought important?		1	2	3	4	5
	n=			4(6.2%)	26(40.6)	34(53.1)
Easy to understand?		1	2	3	4	5
	n=		1(1.6%)	2(3.1%)	23(35.9)	38(59.4)
Careful in his/her work?		1	2	3	4	5

3. How did you feel about the survey method itself (the inspection and measurement of the house)?

Was it:	YES	NO
More detailed than you expected?	n=37 (62.7%)	n=22 (37.3%)
Thorough enough to accurately assess your house?	n=59 (95.2%)	n=3 (4.8%)

4. How did you feel about the total time required for the advisor's visit? (Indicate one statement only.)

Was it:

Just about the right time to conduct and discuss the survey?	n=50 (78.1%)
Too long?	n= 5 (7.8%)
Not long enough?	n= 8 (12.5%)
Did not complete survey and had to return later?	n= 1 (1.6%)
Other (Please specify)	

5. How did you feel about the advisor's performance?

Was it:

	YES	NO
Presented in a manner that made the information easy to understand?	n=60(100%)	
Helpful in showing you a more effective approach to energy conservation?	n=50(90.9%)	n=5 (9.1%)

6. How helpful was the brochure you received before the advisor's visit? n=64

Very helpful	n=14 (21.9%)
Somewhat helpful	n=31 (48.4%)
Not helpful at all	n= 2 (3.1%)
Did not receive a brochure	n=17 (26.6%)

7. Did the actual visit conform to your expectations based on materials you received and the phone call from ShawMont? n=61

YES n=54 (88.5%)

NO n= 7 (11.5%)

8. If your answer to Question #7 was "NO", in what way did the actual visit differ from what you expected? (Use back of page if more space is required) n=8

9. How helpful were the brochures and materials you received in the homeowner information kit? n=62

Very helpful	n=26 (41.9%)
Somewhat helpful	n=34 (54.8%)
Not helpful at all	n= 2 (3.2%)
Did not receive any brochures and materials	

10. Did you find that the recommendations presented by the advisor were:

	YES	NO	SOMEWHAT
Easy to understand? n=62	n=61 (98.4%)		n=3 (1.6%)
Realistic in estimating savings? n=51	n=35 (68.6%)	n=1 (2.0%)	n=15 (29.4%)
Practical for you situation? n=49	n=33 (67.3%)	n=1 (2.0%)	n=15 (30.6%)
No recommendations given? n=2	n=2		

11. Which of the following responses best describes the information you received on available government grants for energy conservation measures? n=64

Very helpful in providing me with information on programs and funds available	n=46 (71.9%)
Somewhat helpful but unsure whether or not I am eligible	n=12 (18.7%)
Not helpful at all	n= 5 (7.8%)
No information was provided to me	n= 1 (1.6%)

12. Do you feel that a home energy advisory service of this sort is needed by Newfoundland homeowners? n=62

YES n=57 (91.9%)

NO n= 5 (8.1%)

13. Did the advisor find any problems that you were not previously aware of? n=63

YES n=38 (60.3%)

NO n=25 (39.7%)

If yes, please explain.

n=38

14. Of the total number of recommendations you received from the survey, approximately what percentage will you carry out?

0% n=4 (6.3%)

1 - 25% n-11 (17.5%)

26 - 50% n=15 (23.8%)

51 - 75% n=16 (25.4%)

76 - 99% n= 8 (12.7%)

100% n= 9 (14.3%)

15. Do you feel your home's energy cost or consumption this winter will decrease as a result of the advisor's visit and your actions?

YES n=50 (80.6%)

NO n=12 (19.4%)

16. If your answer to Question #15 was "YES" what would you estimate your degree of energy or cost reduction will be for this year?

5 - 10%	n=23 (45.1%)
10 - 25%	n=22 (43.1%)
25 - 50%	n= 4 (7.8%)
more than 50%	n= 2 (3.9%)

17. Would you recommend the Home Energy Advisory Service to others?

A. YES	n=54 (83.1%)
B. YES, but with reservations	n= 8 (12.3%)
C. NO	n= 3 (4.6%)

18. If your answer to Question #17 was "B", waht are your reservations about the service?

n=8 ____________________

19. If a private company was offering this service, would you be willing to pay for an energy survey of your home?

YES n=32 (51.6%) NO n=30 (48.4%)

If "YES", approximately how much would you be willing to pay? n=28 ____________________

20. Did you ever submit a questionnaire to the EnerSave program and receive an evaluation of your home by that method? n=63

YES	n=16 (25.4%)
NO	n=47 (74.6%)

21. If your answer to Question #20 was "YES", how did the information you received from the Ener$ave Survey compare with that received in the present survey? n=13

Was it:

More useful than the present survey? ____________

About the same? n=2 (15.4%)

Less useful than the present survey? n=11 (84.6%)

22. Comments (Optional).

n=28 ____________

The following is optional but preferable:

NAME: ____________

ADDRESS: ____________

THANK YOU FOR YOUR COOPERATION

APPENDIX B

HOMEOWNER COMMENTS

APPENDIX B

8. If your answer to Question #7 was "No", in what way did the actual visit differ from what you expected?

   - No brochure was received. Phone call only set up appointment time.
   - I thought there would be more testing done, as far as I am concerned there was none.
   - More detailed and more time-consuming, but well justified.
   - It was expected that a thorough probing and analysis of energy losing areas/points would be done in order to assist the owner in taking corrective measures. The analysis completed was based on assumption unknown to the owner. Therefore, realistic comparison was not possible.
   - It was more informative than expected.
   - I was told it would not take any of my time, but to be most beneficial the homeowner must be present and with the advisor for the inspection.
   - Not applicable, survey completed because of last minute cancellation at another home.
   - Use of house plans instead of visual inspection of insulation; no attention paid to loss of energy from outlets and electric plugs etc; no consideration to fireplace heat loss; no consideration to garage which is heated.

13. Did the advisor find any problems that you were not previously aware of? If yes, please explain.

    - Drafts - windows, doors, cupboards and holes in wall.
    - Furnace not operating to full capacity.
    - Insufficient insulation.
    - Efficiency problems with the furnace.
    - Techniques for sealing.

- Servicing of furnace.
- Adjustments to furnace for better efficiency.
- Holes in closet ceilings (several).
- Basement storm windows.
- Air leakage in floor and ceiling mouldings.
- Caulking around sills inside and out, using ground sheet on crawl space in basement.
- Open basement should be insulated including floor.
- There was a moisture problem in the attic which was pointed out, that I was unaware of.
- I had no method of doing the fuel efficiency test.
- Low efficiency of existing heating system.
- Caulking in places I did not consider to be necessary.
- Since mine was a recent house purchase I was glad to receive all general information regarding energy ratings and problems, particularly that I had a thermostat problem with my furnace.
- Furnace test, learned about varying fuel nozzels.
- Insulation being blown in the walls and old furnace needs to be changed.
- Addition of more insulation in the attic.
- The pipes leading out from sink to basin.
- Lots of minor details, the major things I was already aware of.
- Furnace efficiency, ventilation, sealing.
- Drafts around exterior wall electrical outlets.
- He did find a dampness on the insulation in the attic and urged me to have better ventilation in the eaves, but I remembered after he left that I had discovered a leak around the chimney that I had already repaired. It has since all dried up.

- Furnace settings that could be adjusted.
- Fan needed in kitchen and bathroom, miscellaneous protection from drafts.
- The advisor made us aware that the fuel ratio in the furnace was costing us much fuel.
- Insulation use, hot water boiler protection furnace adjustments and controls.
- Furnace not working as well as it should, only 68% efficiency now its up to 75%.
- Turned down temperature on hot water boiler.
- Caulked windows in winter.
- Furnace problems.
- I was not aware of the extent of prior performance of my furnace.
- Furnace nozzle is too large. He recommended a smaller one be tried. Much heat lost through basement walls.
- Reducing domestic hot water to 120°F. Placement of disc in shower heads. Installation of solenoid valve on heating fuel supply line.
- Hot water tank leaking on inside.
- Furnace efficiency. Hot water suggestions (i.e. electric hot water boiler for summer).
- Draft around window frames/wall plugs and attic hatch.
- Hot water tank set on 140°. Reduced to 120° same amount of hot water.
- The crawl space under my house could be better insulated.
- The only thing was I had to get reducers for shower and taps.

APPENDIX X

DATA BASE MANAGEMENT PROGRAM LISTINGS

MAKEFILE

```
1 'PROGRAM*******MAKEFILE*******

10 'CREATE/MODIFY EDIT FILE "B:EDIT.DAT"

20 'RECORD FORMAT:

22 'INT. 1=MAX. STRING LENGTH

24 'INT. 2=MIN. NUMERIC VALUE

26 'INT. 3=MAX. NUMERIC VALUE(WITH ABOVE DEFINES RANGE)

27 '

28 'INT. 4=STEP VALUE WITHIN RANGE

30 'STRING

32 '     BYTE 1=EDIT CODE

34 '          2=VARIABLE TYPE

70 INPUT "FUNCTION ([C]REATE OR [M]ODIFY OR [L]IST";F$

80 IF F$="C" THEN 100
             ELSE IF F$="M" THEN 1000
             ELSE IF F$="L" THEN 5000
             ELSE GOTO 70

100 'CREATE NEW FILE

105 OPEN "O",#1,"EDIT.DAT"

107 N1%=1 : N2%=800

110 FOR N%=N1% TO N2% : PRINT N%

112 L1%=0:L2%=0:L3%=0:L4%=0:E$="U"

122 INPUT "LENGTH ";L1%

125 IF L1% =0 THEN 305

130 INPUT "MIN ";L2%

140 INPUT "MAX ";L3%

150 INPUT "STEP ";L4%

160 INPUT "CODE";A$

170 INPUT "TYPE";B$

300 E$=A$+B$

305 PRINT #1,L1%,L2%,L3%,L4%,E$

400 NEXT N%

500 CLOSE : STOP

1000 'MODIFY
```

MAKEFILE

```
1010 DIM L%(4,800),E$(800)

1020 OPEN "I",#1,"EDIT.DAT"

1030 FOR M%=1 TO 800

1040 INPUT #1,L%(1,M%),L%(2,M%),L%(3,M%),L%(4,M%),E$(M%)

1050 NEXT M%

1100 INPUT "RANGE OF QUESTION NUMBER VALUES TO MODIFY ";N1%,N2%

1105 IF N1%>0 THEN 1200

1110 CLOSE :
       KILL "EDIT.DAT"

1120 OPEN "O",#1,"EDIT.DAT"

1130 FOR M%=1 TO 800  :
       PRINT #1,L%(1,M%),L%(2,M%),L%(3,M%),L%(4,M%),E$(M%)

1140 NEXT M%

1150 CLOSE :STOP

1200 FOR N%=N1% TO N2%

1205 PRINT N%;"  ";

1210 INPUT "CHANGE WHICH VALUE ";V%

1215 IF V%=0 THEN 1400:'NEXT N%

1220 ON V% GOTO 1230,1240,1250,1260,1270,1280

1230 INPUT "LENGTH ";L%(1,N%):GOTO 1210

1240 INPUT "MINIMUM ";L%(2,N%) :GOTO 1210

1250 INPUT "MAXIMUM "; L%(3,N%) : GOTO 1210

1260 INPUT "STEP ";L%(4,N%) : GOTO 1210

1270 INPUT "CODE ";C$; IF LEN(C$)<>1 THEN 1270
     ELSE E$(N%)=C$+RIGHT$(E$(N%),1)

1275 GOTO 1210

1280 INPUT "TYPE ";C$:IF LEN(C$)<>1 THEN 1280
     ELSE E$(N%)=LEFT$(E$(N%),1)+C$

1285 GOTO 1210

1400 NEXT N%

1410 GOTO 1100

5000 'LIST FILE EDIT.DAT
```

```
5002 LINES=100 :PAGE=0

5003 F$="     ###        ##     ###    ####    ##       !       !"

5010 OPEN "I",#1,"EDIT.DAT"

5020 FOR L%=1 TO 800

5030 INPUT #1,L1%,L2%,L3%,L4%,E$

5040 IF L1%=0 THEN 6000

5050 IF LINES<56 THEN 5500

5060 PAGE=PAGE+1 : LINES=0

5065 IF PAGE=1 THEN 5100

5070 FOR LL%=1 TO 6 : PRINT : NEXT LL%

5100 PRINT "DATA SPECIFICATIONS";TAB(40);"PAGE ";PAGE

5110 PRINT

5120 PRINT "QUESTION # -- LENGTH -- MIN -- MAX -- STEP -- CODE -- TYPE"

5130 PRINT

5500 LINES=LINES+1

5510 PRINT USING F$;L%,L1%,L2%,L3%,L4%,
                     LEFT$(E$,1),RIGHT$(E$,1)

6000 NEXT L%

6010 STOP

9999 END
```

DATAEDIT

```
1 'PROGRAM **********DATAEDIT*********

2 INPUT "OUTPUT SENT TO [S]CREEN OR [P]RINTER";OP$

4 IF OP$="S" THEN BB$="PRINT"
     ELSE IF OP$="P" THEN  BB$="LPRINT":
     GOTO 30

30 K$="**-ANSWER # "

40 DIM A$(800),L%(4,753),E$(753) :
   OPEN "I",#1, "EDIT.DAT"

70 FOR I%=1 TO 753:
   INPUT#1,L%(1,I%),L%(2,I%),L%(3,I%),L%(4,I%),E$(I%) :
   NEXT I%:
   CLOSE 1

100 INPUT "DISK # ";D$ :
    OPEN "I",1,"B:DK"+D$+".NAM"

120 IF EOF(1) THEN STOP

130 LINE INPUT #1,X$ :  OPEN "I",3,"B:"+X$

170 FOR I%=1 TO 800:
    LINE INPUT #3,A$(I%):
    NEXT I%

180 PRINT"---------------------":
    PRINT "AUDIT FILE ";X$;" DATED ";
    A$(1);" BY ";A$(2);" ON ";A$(6):
    I%=0

200 I%=I%+1:
    IF I%=754 THEN 800

205 IF E$(I%)<>"U" THEN 260

220 IF A$(I%)=" "THEN 730

250 GOTO 730

260 C%=VAL(LEFT$(E$(I%),1)):
    A%=LEN(A$(I%)):
    IF I%<73 OR I%>75 OR A$(71)>"1" THEN 320

290 IF A$(71)="1" AND I%=75 THEN 300 ELSE 310

300 L%(2,I%)=200:L%(3,I%)=3000:GOTO 320

310 C%=4

320 ON C% GOTO 340,360,380,400

340 IF A%=L%(1,I%) THEN 440 ELSE 410

360 IF A%<=L%(1,I%) THEN 440 ELSE 410

380 IF A%<=L%(1,I%) AND A%>0 THEN 440 ELSE 410
```

```
400 IF A%=L%(1,I%) OR A%=0 THEN 440

410 PRINT K$;I%;" LENGTH ERROR >";A$(I%);", IS ";A%;
    "  SHOULD BE ";L%(1,I%);" CODE ";C%:
    GOTO 730

440 T$=RIGHT$(E$(I%),1):
    IF T$<>"N" AND T$<>"I" THEN 510

450 FOR M%=1 TO A%:
    R$=MID$(A$(I%),M%,1):
    IF R$<"0" OR R$>"9" THEN 480 ELSE NEXT M%

470 GOTO 510

480 PRINT K$;I%;"NON-NUMERIC CHARACTER(S) IN TYPE ";T$;" >";A$(I%);"<":
    GOTO 730

510 IF T$<>"L" THEN 560

520 IF A$(I%)="0" OR A$(I%)="1" OR A$(I%)="" THEN 560

530 PRINT K$;I%;"OF A NO/YES NATURE HAS A VALUE OF >";A$(I%);"<":
    GOTO 730

560 IF L%(2,I%)=0 AND L%(3,I%)=0 THEN 660

570 IF (C%=4 OR C%=2) AND A$(I%)="" THEN 660

580 A%=VAL(A$(I%)):
    IF L%(4,I%)=1 THEN 640

600 FOR M%=L%(2,I%) TO L%(3,I%) STEP L%(4,I%):
    IF M%=A% THEN 660 ELSE NEXT M%

630 PRINT K$;I%;" = ";A$(I%);
    " OUT OF RANGE ( "; L%(2,I%);" - ";L%(3,I%);
    ") OR STEP ( "; L%(4,I%);")":
    GOTO 730

640 IF A%<L%(2,I%) OR A%>L%(3,I%) THEN 630

660 IF T$<>"D" THEN 730

665 IF A$(I%)="" AND  (C%=4 OR C%=2) THEN 730

670 A%=VAL(MID$(A$(I%),3,2)):
    IF A%>=1 AND A%<=12 THEN 690

680 LPRINT K$;I%;" = ";A$(I%);" INVALID DATE ":
    GOTO 730

690 A$=LEFT$(A$(I%),2):
    IF A$<>"81" AND A$<>"82" THEN 680

700 B%=VAL(MID$(A$(I%),5,2)):
    C%=VAL(A$):N%=28:
    IF C% MOD 4=0 THEN N%=29
```

```
710 IF A%=2 AND B%>N% THEN 680 ELSE
    IF(A%=4 OR A%=6 OR A%=9 OR A%=11)
    AND B%>30 THEN 680 ELSE
    IF B%>31 OR B%<1 THEN 680

730 GOTO 200

800 ERASE A$:K$=" OUT OF RANGE "

810 INPUT #3,F%,D%,S%:
        IF F% < 50 OR F% > 250 THEN
        PRINT K$; " FREE HEAT = ";F%

820 IF D% < 20 OR D% > 75 THEN
        PRINT K$; " DHW USED = ";D%

830 IF S% < 0  OR S% > 20 THEN
        PRINT K$; "SINGLE WINDOW COUNT =";S%

840 INPUT #3,F%,D%,S%:
        IF F% < 0 OR F%> 4 THEN
        PRINT K$; "SINGLE DOOR COUNT = ";S%

850 IF D%< 1 OR D%> 8 THEN
        PRINT K%; "MOISTURE RATING = ";D%

860 INPUT #3,F%,D%,S%:
        INPUT #3,R,H,S:
        IF R<1.5 OR R>3.5 THEN
        PRINT K$; "RCF = ";R

870 IF H<.6 OR H>1 THEN
        PRINT K$; "HEAT FCTR = ";H

880 IF S<20 OR S>1400 THEN
        PRINT K$; "SLCFTR = ";S

890 INPUT #3,R,H,S:
        IF R<500 OR R>3000 THEN
        PRINT K$; "CLCHC = ";R

900 IF H<30 OR H>400 THEN
        PRINT K$; "TOT ENV AREA = ";H

910 IF S<150 OR S>1000 THEN
        PRINT K$; "CONDLOSS = ";S

920 INPUT #3,R,H,S:
        IF R<40 OR R>500 THEN
        PRINT K$; " ACLOSS = ";R

930  IF H< 100 OR H>1400 THEN
     PRINT K$;"DHWCOST = ";H

940 IF S<500 OR S>3500 THEN
        PRINT K$; "SPCHTCOST = ";S

950 INPUT #3,R,H,S:
        IF R<120 OR R>1400 THEN
        PRINT K$; "REPLACOST = ";R

960 IF H<10 OR H>1000 THEN
        PRINT K$; "SBYCOST = ";H
```

```
970 IF S<200 OR S>1500 THEN
      PRINT K$; "HTNGLOAD = ";S

980 INPUT #3,R,H,S:
      IF R<0 OR R>2000 THEN
      PRINT K$; "SAVENV = ";R

990 IF H<0 OR H>2000 THEN
      PRINT K$; "SAVOIL = ";H

1000 IF S<0 OR S>1800 THEN
      PRINT K$; "SAVTOT = ";S

1010 INPUT #3,R,H,S:
      IF R<.5 OR R>10 THEN
      PRINT K$; "ACE = ";R

1020 IF H<5 OR H>30 THEN
      PRINT K$; "AVGTMP = ";H

1030 IF S<-5 OR S>5 THEN
      PRINT K$; "TSTATERR = ";S

1040 INPUT #3,R,H,S:
      IF R<1.02 OR R>1.2 THEN
      PRINT K$; "ENVINDEX = ";R

1050 IF H<.26 OR H>.3 THEN
      PRINT K$; "COSTOIL = ";H

1060 IF S<>.34 THEN
      PRINT K$; "COSTOIL83 = ";S

1070 INPUT #3,R,H,S:
      IF (R<710 OR R>1450) AND R<>0 THEN
      PRINT K$; "CHIMCOST = ";R

1080 IF H<0 OR H>700 THEN
      PRINT K$; "WDHWSAVING = ";H

2000 DIM A$(800)

7730 K$="**-ANSWER # "

7740 CLOSE 3:
      GOTO 120

7750 END
```

EDIT.DAT

```
DATA SPECIFICATIONS                        PAGE  1
                                                                  EDIT.DAT
QUESTION # -- LENGTH -- MIN -- MAX -- STEP -- CODE -- TYPE

       1          6        0       0      0       1       D
       2          3        0       0      0       1       C
       3         21        0       0      0       3       C
       4          3        0       0      0       1       N
       5          7        0       0      0       4       N
       6         21        0       0      0       3       C
       7         21        0       0      0       3       C
       8         13        0       0      0       3       C
       9          4        0       0      0       1       C
      10          6        0       0      0       1       C
      11         21        0       0      0       3       C
      12         13        0       0      0       3       C
      13          4        0       0      0       1       C
      14         10        0       0      0       1       C
      21          1        1       6      1       1       N
      22          3        1     200      1       1       I
      23          2        5      30      5       1       N
      24          1        1       5      1       1       N
      25          1        1       2      1       1       N
      26          1        1       5      1       1       N
      27          2        0      20      1       1       I
      31          2        5      86      1       1       I
      32          2        5      86      1       1       I
      33          2        5      86      1       1       I
      34          2        0      30      1       1       C
      35          2        0      99      1       1       I
      36          2        1      86      1       1       I
      37          1        0       1      1       1       N
      38          1        0       2      1       1       N
      41          1        0       0      0       1       L
      42          1        0       0      0       1       L
      43          2        0      50      1       1       I
      44          2        0      50      1       1       I
      51          1        0       0      0       1       L
      52          1        0       2      1       1       N
      53          1        0       2      1       1       N
      54          1        0       2      1       1       N
      61          1        0       2      1       1       N
      62          1        0       2      1       1       N
      63          4        0    4444      0       3       N
      64          1        0       0      0       1       L
      65          1        0       0      0       1       L
      70          1        1       5      1       1       N
      71          1        0       3      1       1       N
      72          1        0       0      0       1       L
      73          6        0       0      0       1       D
      74          4        0    9999      1       4       I
      75          4        0    3000      1       4       I
      76          6        0       0      0       4       D
      77          4        0    9999      1       4       I
      78          4        0    9999      1       4       I
      79          6        0       0      0       4       D
      80          4        0    9999      1       4       I
      81          4        0    9999      1       4       I
      82          6        0       0      0       4       D
      83          4        0    9999      1       4       I
```

```
DATA SPECIFICATIONS                    PAGE  2                EDIT.DAT

QUESTION # -- LENGTH -- MIN -- MAX -- STEP -- CODE -- TYPE

    84          4        0     9999      1       4       I
    85          6        0        0      0       4       D
    86          4        0     9999      1       4       I
    87          4        0     9999      1       4       I
    88          6        0        0      0       4       D
    89          4        0     9999      1       4       I
    90          4        0     9999      1       4       I
    91          6        0        0      0       4       D
    92          4        0     9999      1       4       I
    93          4        0     9999      1       4       I
    94          6        0        0      0       4       D
    95          4        0     9999      1       4       I
    96          4        0     9999      1       4       I
   101          1        0        6      1       1       N
   102          1        1        4      1       4       N
   103          4        1     9999      1       4       I
   104          4        0     9999      1       4       I
   105          1        0        2      1       1       N
   106          3       40      999      1       4       I
   107          1        0        0      0       4       L
   108          1        0        0      0       1       L
   110          2        1       99      1       4       I
   111          6        0        0      0       4       D
   112          4        1     9999      1       4       I
   113          1        0        0      0       4       L
   114          2        1       99      1       4       I
   115          6        0        0      0       4       D
   116          4        1     9999      1       4       I
   117          1        0        0      0       4       L
   118          2       20       40      1       4       I
   119          6        0        0      0       4       D
   120          4       50     2000      1       4       I
   121          1        0        0      0       4       L
   122          2       20       40      1       4       I
   123          6        0        0      0       4       D
   124          4       50     2000      1       4       I
   125          1        0        0      0       4       L
   126          2       20       40      1       4       I
   127          6        0        0      0       4       D
   128          4       50     2000      1       4       I
   129          1        0        0      0       4       L
   130          2       20       40      1       4       I
   131          6        0        0      0       4       D
   132          4       50     2000      1       4       I
   133          1        0        0      0       4       L
   134          2       20       40      1       4       I
   135          6        0        0      0       4       D
   136          4       50     2000      1       4       I
   137          1        0        0      0       4       L
   138          2       20       40      1       4       I
   139          6        0        0      0       4       D
   140          4       50     2000      1       4       I
   141          1        0        0      0       4       L
   142          2       20       40      1       4       I
   143          6        0        0      0       4       D
   144          4       50     2000      1       4       I
```

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DATA SPECIFICATIONS                    PAGE  3                 EDIT.DAT

QUESTION # -- LENGTH -- MIN -- MAX -- STEP -- CODE -- TYPE

     145          1        0      0      0       4       L
     146          2       20     40      1       4       I
     147          6        0      0      0       4       D
     148          4       50   2000      1       4       I
     149          1        0      0      0       4       L
     150          2       20     40      1       4       I
     151          6        0      0      0       4       D
     152          4       50   2000      1       4       I
     153          1        0      0      0       4       L
     154          2       20     40      1       4       I
     155          6        0      0      0       4       D
     156          4       50   2000      1       4       I
     157          1        0      0      0       4       L
     201          4        0      0      0       4       N
     202          4        0      0      0       4       N
     203          4        0      0      0       4       N
     204          4        0      0      0       4       N
     205          4        0      0      0       4       N
     206          4        0      0      0       4       N
     207          4        0      0      0       4       N
     208          4        0      0      0       4       N
     209          4        0      0      0       4       N
     210          4        0      0      0       4       N
     211          4        0      0      0       4       N
     212          4        0      0      0       4       N
     213          4        0      0      0       4       N
     214          4        0      0      0       4       N
     215          4        0      0      0       4       N
     216          4        0      0      0       4       N
     217          4        0      0      0       4       N
     218          4        0      0      0       4       N
     219          4        0      0      0       4       N
     220          4        0      0      0       4       N
     221          4        0      0      0       4       N
     222          4        0      0      0       4       N
     223          4        0      0      0       4       N
     224          4        0      0      0       4       N
     225          4        0      0      0       4       N
     226          4        0      0      0       4       N
     227          4        0      0      0       4       N
     228          4        0      0      0       4       N
     229          4        0      0      0       4       N
     230          4        0      0      0       4       N
     231          4        0      0      0       4       N
     232          4        0      0      0       4       N
     233          4        0      0      0       4       N
     234          4        0      0      0       4       N
     235          4        0      0      0       4       N
     236          4        0      0      0       4       N
     237          4        0      0      0       4       N
     238          4        0      0      0       4       N
     239          4        0      0      0       4       N
     240          4        0      0      0       4       N
     241          4        0      0      0       4       N
     242          4        0      0      0       4       N
     243          4        0      0      0       4       N
```

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DATA SPECIFICATIONS                         PAGE  4                 EDIT.DAT

QUESTION # -- LENGTH -- MIN -- MAX -- STEP -- CODE -- TYPE

     244          4       0       0      0       4       N
     245          4       0       0      0       4       N
     246          4       0       0      0       4       N
     247          4       0       0      0       4       N
     248          4       0       0      0       4       N
     249          4       0       0      0       4       N
     250          4       0       0      0       4       N
     251          4       0       0      0       4       N
     252          4       0       0      0       4       N
     253          4       0       0      0       4       N
     254          4       0       0      0       4       N
     255          4       0       0      0       4       N
     256          4       0       0      0       4       N
     261          3       0       0      0       4       N
     262          3       0       0      0       4       N
     263          3       0       0      0       4       N
     264          3       0       0      0       4       N
     265          3       0       0      0       4       N
     266          3       0       0      0       4       N
     267          3       0       0      0       4       N
     268          3       0       0      0       4       N
     271          1       0       2      1       1       N
     272          1       0       2      1       1       N
     273          1       0       2      1       1       N
     280          2       5      86      1       1       I
     281          2       5      30      1       1       I
     282          1       0       0      0       1       L
     300          2      30      99      1       1       I
     301          1       0       0      0       1       L
     302          1       0       0      0       1       L
     303          1       0       0      0       1       L
     310          3       0     999      1       4       I
     311          2       0      99      1       4       I
     312          3       0     999      1       4       I
     313          2       0      99      1       4       I
     314          3       0     999      1       4       I
     315          2       0      99      1       4       I
     316          3       0     999      1       4       I
     317          2       0      99      1       4       I
     318          3       0     999      1       4       I
     319          2       0      99      1       4       I
     320          1       0       3      1       4       N
     321          3       0     999      1       4       I
     322          1       0       3      1       4       N
     323          3       0     999      1       4       I
     324          1       0       3      1       4       N
     325          3       0     999      1       4       I
     326          1       0       3      1       4       N
     327          3       0     999      1       4       I
     330          3       0     999      1       4       I
     331          2       0      99      1       4       I
     332          3       0     999      1       4       I
     333          2       0      99      1       4       I
     334          3       0     999      1       4       I
     335          2       0      99      1       4       I
     336          3       0     999      1       4       I
```

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DATA SPECIFICATIONS                         PAGE  5                  EDIT.DAT

QUESTION # -- LENGTH -- MIN -- MAX -- STEP -- CODE -- TYPE

      337          2        0      99      1       4       I
      338          3        0     999      1       4       I
      339          2        0      99      1       4       I
      340          1        0       3      1       4       N
      341          3        0     999      1       4       I
      342          1        0       3      1       4       N
      343          3        0     999      1       4       I
      344          1        0       3      1       4       N
      345          3        0     999      1       4       I
      346          1        0       3      1       4       N
      347          3        0     999      1       4       I
      350          3        0     999      1       4       I
      351          2        0      99      1       4       I
      352          3        0     999      1       4       I
      353          2        0      99      1       4       I
      354          3        0     999      1       4       I
      355          2        0      99      1       4       I
      356          3        0     999      1       4       I
      357          2        0      99      1       4       I
      358          3        0     999      1       4       I
      359          2        0      99      1       4       I
      360          1        0       3      1       4       N
      361          3        0     999      1       4       I
      362          1        0       3      1       4       N
      363          3        0     999      1       4       I
      364          1        0       3      1       4       N
      365          3        0     999      1       4       I
      366          1        0       3      1       4       N
      367          3        0     999      1       4       I
      370          3        0     999      1       4       I
      371          3        0     999      1       4       I
      372          3        0     999      1       4       I
      373          3        0     999      1       4       I
      374          3        0     999      1       4       I
      375          3        0     999      1       4       I
      376          3        0     999      1       4       I
      377          3        0     999      1       4       I
      378          3        0     999      1       4       I
      379          3        0     999      1       4       I
      380          1        0       3      1       4       N
      381          3        0     999      1       4       I
      382          1        0       3      1       4       N
      383          3        0     999      1       4       I
      384          1        0       3      1       4       N
      385          3        0     999      1       4       I
      386          1        0       3      1       4       N
      387          3        0     999      1       4       I
      390          3        0     999      1       4       I
      391          3        0     999      1       4       I
      392          3        0     999      1       4       I
      393          3        0     999      1       4       I
      394          3        0     999      1       4       I
      395          3        0     999      1       4       I
      396          3        0     999      1       4       I
      397          3        0     999      1       4       I
      398          3        0     999      1       4       I
```

EDIT.DAT

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DATA SPECIFICATIONS                              PAGE  6

QUESTION # -- LENGTH -- MIN -- MAX -- STEP -- CODE -- TYPE

     399          3        0     999     1        4       I
     400          1        0       3     1        4       N
     401          3        0     999     1        4       I
     402          1        0       3     1        4       N
     403          3        0     999     1        4       I
     404          1        0       3     1        4       N
     405          3        0     999     1        4       I
     406          1        0       3     1        4       N
     407          3        0     999     1        4       I
     410          3        0     999     1        4       I
     411          3        0     999     1        4       I
     412          3        0     999     1        4       I
     413          3        0     999     1        4       I
     414          3        0     999     1        4       I
     415          3        0     999     1        4       I
     416          3        0     999     1        4       I
     417          3        0     999     1        4       I
     418          3        0     999     1        4       I
     419          3        0     999     1        4       I
     420          1        0       3     1        4       N
     421          3        0     999     1        4       I
     422          1        0       3     1        4       N
     423          3        0     999     1        4       I
     424          1        0       3     1        4       N
     425          3        0     999     1        4       I
     426          1        0       3     1        4       N
     427          3        0     999     1        4       I
     430          3        0     999     1        4       I
     431          3        0     999     1        4       I
     432          3        0     999     1        4       I
     433          3        0     999     1        4       I
     434          3        0     999     1        4       I
     435          3        0     999     1        4       I
     436          3        0     999     1        4       I
     437          3        0     999     1        4       I
     438          3        0     999     1        4       I
     439          3        0     999     1        4       I
     440          1        0       3     1        4       N
     441          3        0     999     1        4       I
     442          1        0       3     1        4       N
     443          3        0     999     1        4       I
     444          1        0       3     1        4       N
     445          3        0     999     1        4       I
     446          1        0       3     1        4       N
     447          3        0     999     1        4       I
     450          3        0     999     1        4       I
     451          3        0     999     1        4       I
     452          3        0     999     1        4       I
     453          3        0     999     1        4       I
     460          1        0       3     1        4       N
     461          3        0     999     1        4       I
     462          1        0       3     1        4       N
     463          3        0     999     1        4       I
     466          1        0       3     1        4       N
     467          3        0     999     1        4       I
     470          3        0     999     1        4       I
```

EDIT.DAT

```
DATA SPECIFICATIONS                        PAGE  7

QUESTION # -- LENGTH -- MIN -- MAX -- STEP -- CODE -- TYPE

     471          3         0     999      1        4        I
     472          3         0     999      1        4        I
     473          3         0     999      1        4        I
     474          3         0     999      1        4        I
     475          3         0     999      1        4        I
     476          3         0     999      1        4        I
     477          3         0     999      1        4        I
     478          3         0     999      1        4        I
     479          3         0     999      1        4        I
     480          1         0       3      1        4        N
     481          3         0     999      1        4        I
     482          1         0       3      1        4        N
     483          3         0     999      1        4        I
     484          1         0       3      1        4        N
     485          3         0     999      1        4        I
     486          1         0       3      1        4        N
     487          3         0     999      1        4        I
     490          3         0     999      1        4        I
     491          3         0     999      1        4        I
     492          3         0     999      1        4        I
     493          3         0     999      1        4        I
     494          3         0     999      1        4        i
     495          3         0     999      1        4        I
     496          3         0     999      1        4        I
     497          3         0     999      1        4        I
     498          3         0     999      1        4        I
     499          3         0     999      1        4        I
     500          1         1       3      1        4        N
     501          3         1     999      1        4        I
     502          1         1       3      1        4        N
     503          3         1     999      1        4        I
     504          1         0       3      1        4        N
     505          3         1     999      1        4        I
     506          1         0       3      1        4        N
     507          3         1     999      1        4        I
     510          3         1     999      1        4        I
     511          3         1     999      1        4        I
     512          3         1     999      1        4        I
     513          3         1     999      1        4        I
     514          3         1     999      1        4        I
     515          3         1     999      1        4        I
     516          3         1     999      1        4        I
     517          3         1     999      1        4        I
     518          3         1     999      1        4        I
     519          3         1     999      1        4        I
     520          2         0      99      1        4        I
     521          2         0      99      1        4        I
     522          2         0      99      1        4        I
     523          2         0      99      1        4        I
     550          9         0       0      0        2        N
     551          9         0       0      0        2        N
     552          9         0       0      0        2        N
     553          9         0       0      0        2        N
     554          9         0       0      0        2        N
     600          1         0       6      1        1        N
     601          3         0     200      1        4        I
```

EDIT.DAT

```
QUESTION # -- LENGTH -- MIN -- MAX -- STEP -- CODE -- TYPE

      602          1        0      0      0        4       L
      603          2        0     99      1        4       I
      604          1        0      0      0        4       L
      605          1        0      0      0        4       L
      606          1        0      0      0        4       L
      607          1        0      0      0        4       L
      608          1        0      0      0        4       L
      609          1        0      0      0        4       L
      610          1        1      5      1        4       N
      612          2        0     99      1        4       I
      614          3        0    400      1        4       I
      615          3        0    350      1        4       I
      620          1        1      4      1        4       N
      622          2        1     50      1        4       I
      623          3        0    350      1        4       I
      624          1        0      0      0        4       L
      625          1        0      0      0        4       L
      640          1        0      9      1        4       I
      641          3        0    160      1        4       I
      642          2        0     15      1        4       I
      643          3        0    999      1        4       I
      644          3      440    999      1        4       I
      645          3        0    999      1        1       I
      720          1        0      0      0        4       L
      721          1        0      0      0        4       L
      722          1        0      0      0        4       L
      723          1        0      0      0        4       L
      724          1        0      0      0        4       L
      725          1        0      0      0        4       L
      730          1        0      0      0        4       L
      731          1        0      0      0        4       L
      732          1        0      0      0        4       L
      733          1        0      0      0        4       L
      734          1        0      0      0        4       L
      740          1        0      0      0        4       L
      741          1        0      0      0        4       L
      742          1        0      0      0        4       L
      743          1        0      0      0        4       L
      744          1        0      0      0        4       L
      750          1        0      0      0        4       L
      751          1        0      0      0        4       L
      752          1        0      0      0        4       L
      753          1        0      0      0        4       L
```

POOR

QUALITY

ORIGINAL